Tekscan

ELF™ User Manual

Single Handle, Multi-Handle, Hi-Speed and Wireless Systems

Economical load & force system

ELF™ User Manual

v. 3.4x

Economical load & force system

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WELCOME

ISO

Tekscan is registered to the following standard(s):

- ISO 9001: 2000
- ISO 13485: 2003

INTRODUCTION

This manual describes how to use Tekscan's ***Economical Load & Force (ELF)***, ***Multi-Handle ELF***, ***Hi-Speed ELF***, and ***Wireless ELF*** systems. These systems are ideal for designers, researchers, or anyone who needs to measure forces without disturbing the dynamics of their tests. The ***FlexiForce*** sensors can be used to measure both static and dynamic forces (up to 1000 lbf.), and are thin enough to enable non-intrusive measurement. Each ***ELF*** system is comprised of FlexiForce's Microsoft (MS) Windows-based software, the associated electronics, and FlexiForce sensors. The ***ELF*** system hardware includes the sensor handle with USB adapter and the sensors. One of the major advantages of this system is that it is simple to install, and requires very little hardware.

The ***ELF*** sensors use a resistive-based technology. The application of a force to the active sensing area of the sensor results in a change in the resistance of the sensing element in inverse proportion to the force applied. After a simple calibration is performed, this force can be displayed on the screen in the measurement units that you choose, such as Pounds or Newtons.

The ***ELF*** software is an 8-bit application that is compatible with Microsoft (MS) Windows 2000/XP/Vista. The software allows you to view a graphical representation of the force on the sensor in real-time, record this information as a "movie," and review and analyze it later. There are a number of options for displaying the real-time force data; it can be displayed as a "strip chart," "column graph," or "digital readout." Recorded "movie frames" can be saved as ASCII (text) files, which can be imported into a spreadsheet program, or opened in a text editor or word processing program. Real-time data or movie frames can also be copied to the Windows clipboard and pasted into other applications as a **.bmp** (bitmap) file.

GETTING ASSISTANCE

Tekscan, Inc. will provide technical assistance for any difficulties you may experience using your ***ELF*** system.

Write, call or fax us with any concerns or questions. Our knowledgeable support staff will be happy to help you. Comments and suggestions are always welcome.

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QUICK START

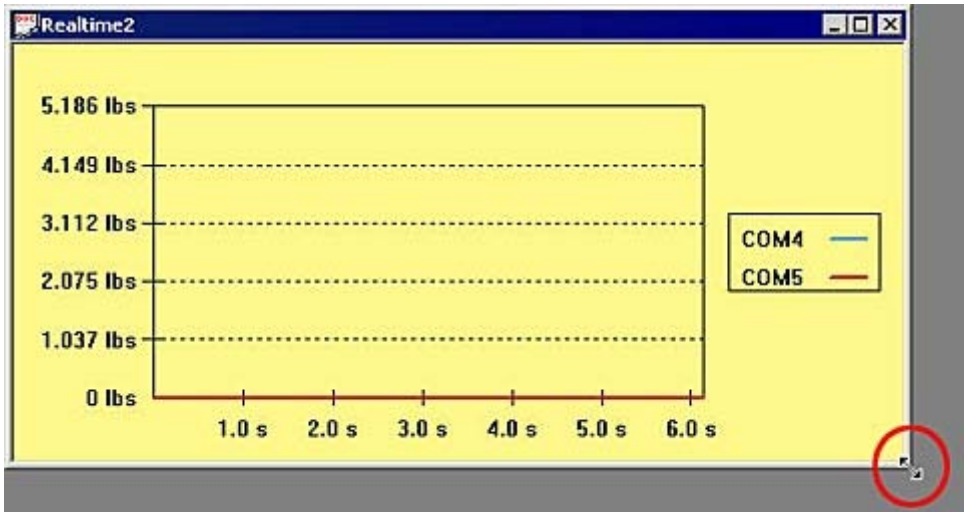
This is a quick look at how to use your ***ELF*** system. This Quick Start procedure should be followed as a general outline; it will give you the basics on how to view sensor force data in a Real-time Window, record this data, play the recording back, and analyze the data. However, you must read the entire manual before designing your application.

Note: This procedure assumes that the ELF software has been successfully installed on your system. In addition, a familiarity with MS Windows is assumed.

1. Make sure the sensors are inserted correctly into the handles. Run the program by clicking the **Start** button at the bottom left of the screen, selecting **Programs**, and then clicking the **ELF Multi** icon.

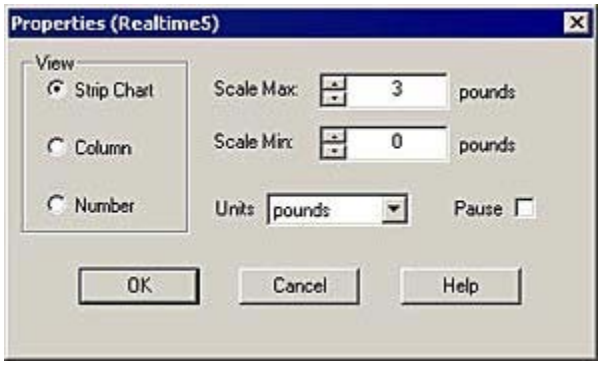
2. If you have the Multi-Handle ***ELF*** system and have connected multiple handles, you will be prompted to select the COM ports/handles you wish to use for testing. Click to place a check in each box, and then select **OK**.

3. A new Real-time window will appear. The size of this window will vary, since MS Windows cascades new windows. If the window is too small to view comfortably, enlarge it by dragging an edge of the window with the cursor (shown below).

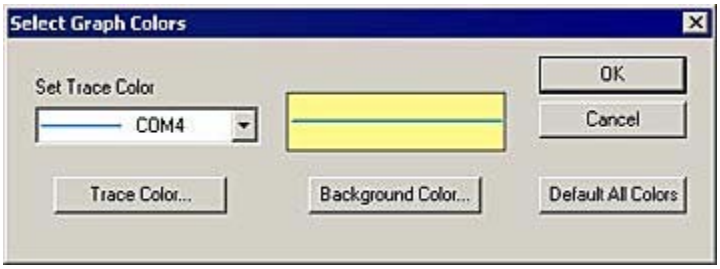


4. Apply the test force to the sensing area of the sensors (refer to the Sensor Loading Considerations section and ensure that the sensors are conditioned before use). The force data will be displayed in the window in the default mode, which is as a "Strip Chart". This shows the data in the form of a chart, with elapsed time (in seconds) on the X-axis, and the selected units (default is "percentage") on the Y-axis.

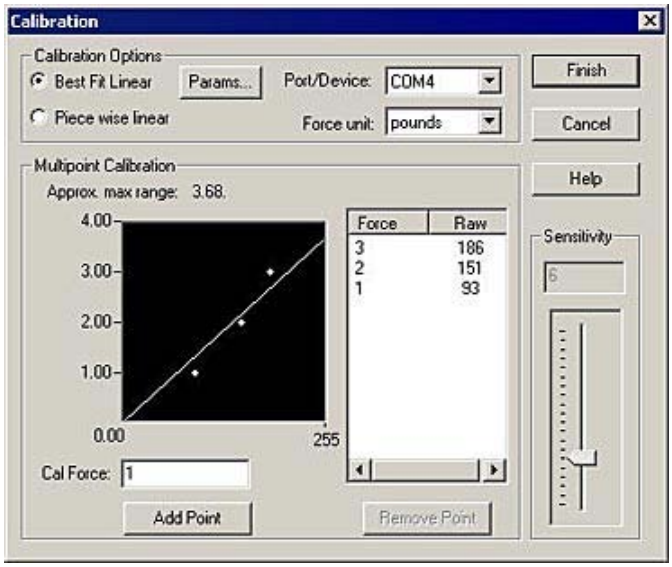
5. Click on **View -> Properties** (or click the right mouse button with the cursor over the Real-time Window) to open the *Properties* dialog box. Make any desired changes to the display settings, and click **OK**.



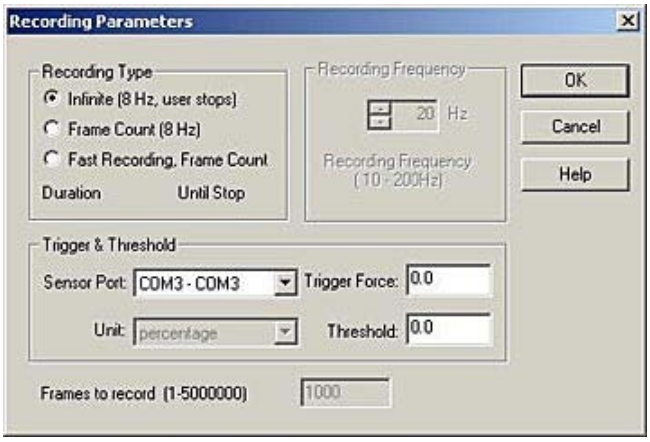
6. If you would like to change the background color of the window, select **Tools -> Select Colors**. The *Select Graph Colors* dialog box will open, and enable you to customize the background color.



7. Calibrate the sensor(s), so that an actual force range can be determined for the sensor's digital output (0 to 255). Refer to the Calibration section for the calibration procedure and guidelines. It is also recommended that you perform a "Sensitivity Adjustment", which is described in the "Calibration" section.



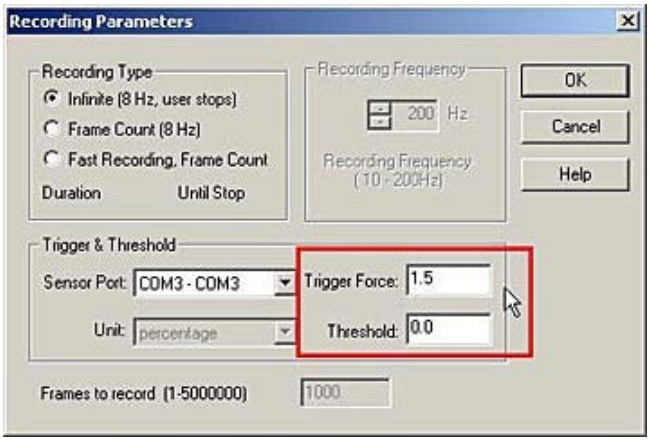
8. Select the desired recording parameters under **Record -> Settings**. The default **Recording Type** is "Infinite (8 Hz, user stops)", but you are given the option to stop the recording after a specific number of frames. You may also set recording frequency, trigger and threshold, as well as frames to record, in this dialog box.



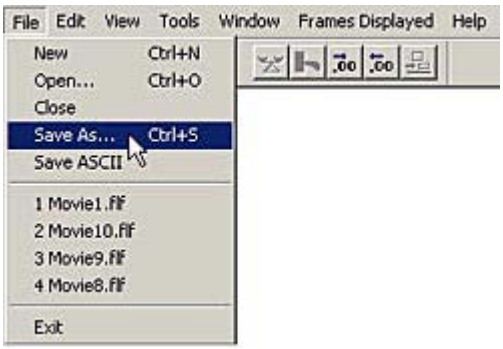
9. Click **Record -> Start** (or the **Start Recording** icon on the Toolbar). The system will begin recording data. If you selected "Infinite (8 Hz, user stops)" as the recording type, you must click **Record -> Stop** (or the **Stop Recording** icon on the Toolbar) to stop recording. Otherwise, recording will stop when the required number of frames have been acquired.

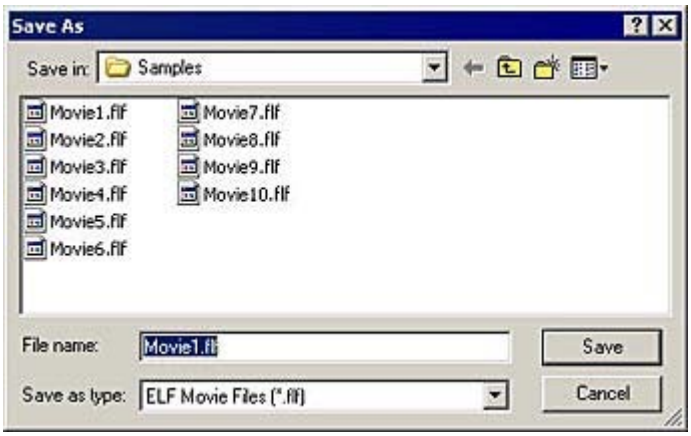
Note: Before an actual recording is made, the sensor should be Calibrated and Conditioned, and a Sensitivity Adjustment should be done (if necessary), as described in later sections. Any information recorded before these are successfully completed may be inaccurate.

The ***ELF*** software also allows you to trigger the start of a recording. If you enter a value in the **Trigger Force** field under **Record -> Settings**, recording will not begin until that force is exerted on the sensor. Force threshold may be selected for each sensor, so that a recording will not begin until the force reaches the threshold. See the Calibration section for more details.

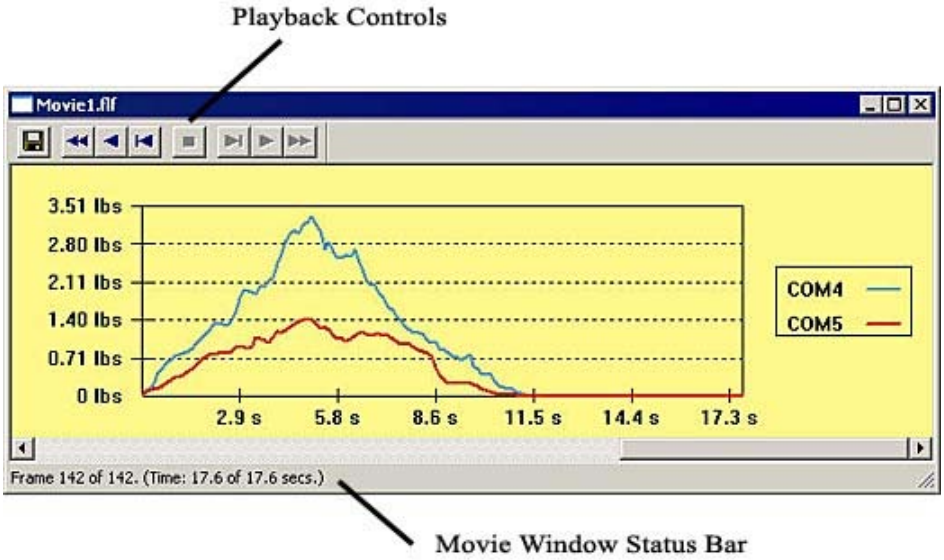


10. Select **File -> Save As** to save the movie. Under **File Name**, enter the desired file name (e.g.: "**test1.flf**") and select the destination (path) where you want to save your recording. Recordings must be saved as ***ELF*** Movie Files (with the extension ***.flf**).



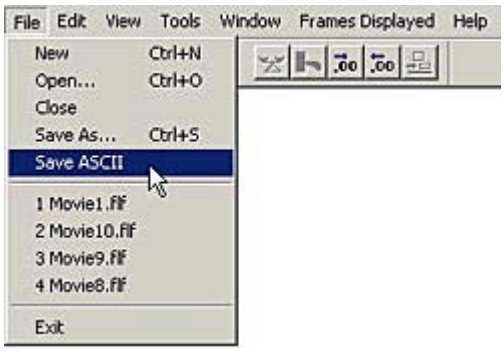


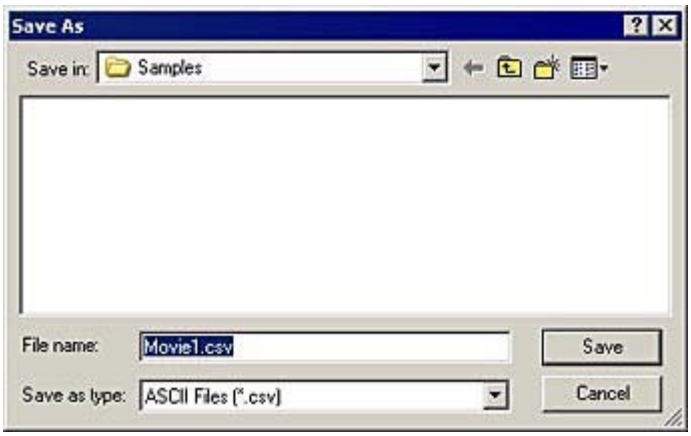
11. Click on one of the **Playback Control** icons on the toolbar at the top of the Movie window to play the movie forward or backward, move one frame forward or backward, move to the first or last frame, or stop the movie.



12. Select **Edit -> Copy**, or click the **Copy** icon on the Toolbar. The contents of the window will be copied to the Windows clipboard, and will be available to be pasted as a graphic (bitmap) into other Windows applications.

13. Select **File -> Save ASCII** to save the movie data as a text file. ASCII files must be saved with the extension ***.csv.** This data can then be viewed by importing it into a spreadsheet program, such as MS Excel, or by opening the text file in a word processing program, such as MS Word.





You have now completed the Quick Start section, and should be acquainted with your ELF software. The rest of the manual gives you specific instructions on how to set up and run your system.

INSTALLATION

Note: If you are using the Wireless ELF System, please refer to the Wireless ELF System section for installation and usage instructions.

For the ***ELF*** software to function properly, your system must have the following minimum requirements:

- Pentium 300 MHz
- 64 MB RAM
- 5 MB of Hard Drive Space
- CD Drive
- One USB 2.0 port per USB Handle
- Windows 2000/XP/Vista

To use the Multi-Handle ***ELF*** software with multiple USB Handles, one USB 2.0 port must be available for each ***ELF*** Handle used. If you require a USB hub, Tekscan recommends the following:

Belkin: USB Plus Hub (7 Ports) ($49.99)
Hi-Speed USB 2.0 7-Port Hub
http://www.belkin.com/
Model # F5U307

IOGEAR ($29.95)
MiniHub
4-port USB 2.0 Hub
http://www.iogear.com/
Model # GUH264

The following displays the ELF system with USB Handles.

Note: Our previous systems shipped with Serial handles. It is not recommended to use both the Serial ELF and USB ELF handles simultaneously.

Note: For the Hi-speed Multi-Handle ELF software using Windows 2000/XP/Vista, you will need a PCI board and we would recommend that you use no more than 4 handles.

ELF COMPONENT IDENTIFICATION

The following lists all the components that come with the ELF system.

(1) ELF USB Handle (single Handle systems -- multiple Handle systems vary depending on requirements). Standard length is 10 feet.

(1) Software CD

(3) FlexiForce B201 Sensors (one in each of the three offered force ranges: Low (0-25 lb); Medium (0-150 lb) and High (0-1000 lb)).

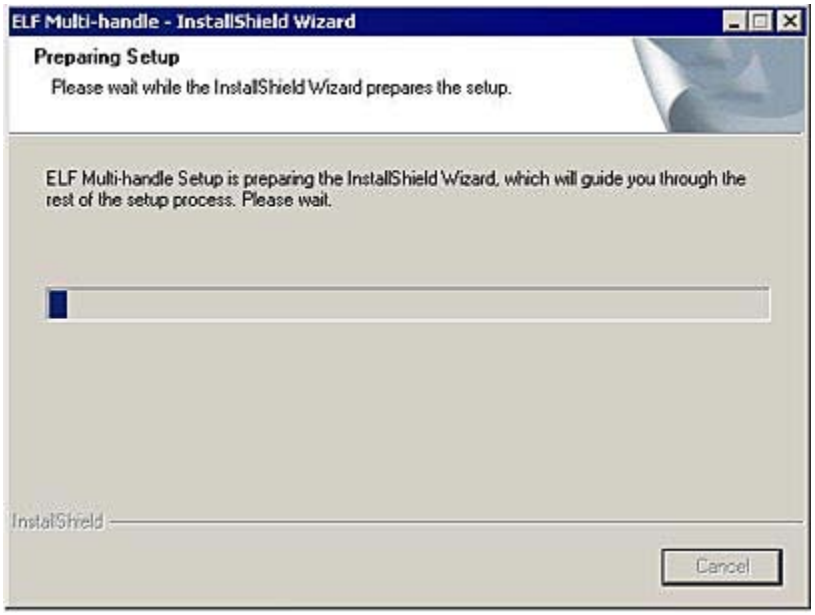
The force range (Low (L), Medium (M), or High (H)) is indicated by one of the 3 checkboxes near the tab end of the sensor. The 12 checkboxes near the sensing area containing one row of letters and one row of numbers are internal manufacturing batch codes, and do not indicate anything about the force range or functionality of the sensor.

Note: You may be required to purchase a USB Hub (for multi-Handle ELF systems). Refer to the "Installation" section for a list of recommended USB Hubs.

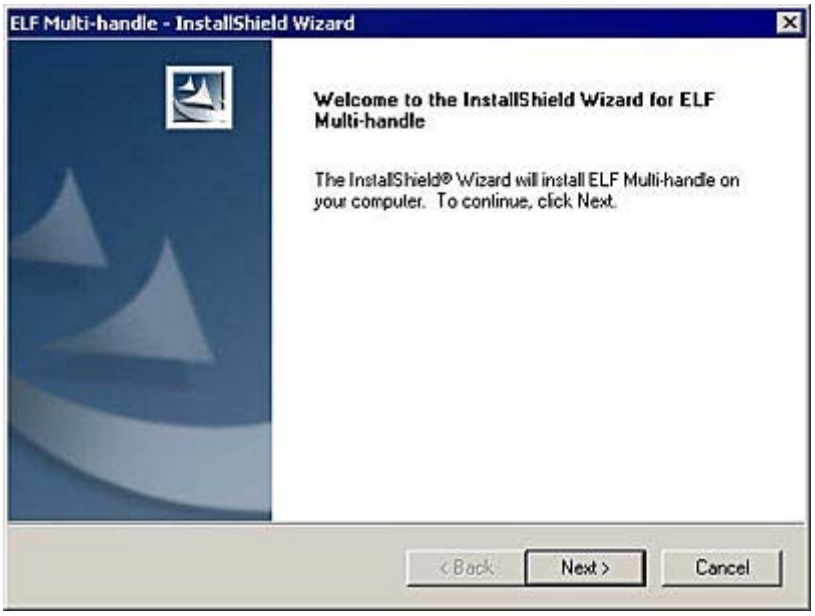
SOFTWARE INSTALLATION

Before installing the ***ELF*** software, close all other applications. To install the software, place the CD-ROM in your CD-ROM drive. If the **autorun.exe** does not start automatically, click on **Start** at the bottom left of the screen, and click on the **Run** menu item. If you put the disk in the **D:** CD-ROM Drive, type "**d:setup**" in the command line field of the *Run* dialog box, then click **OK**. The following images outline the installation process:

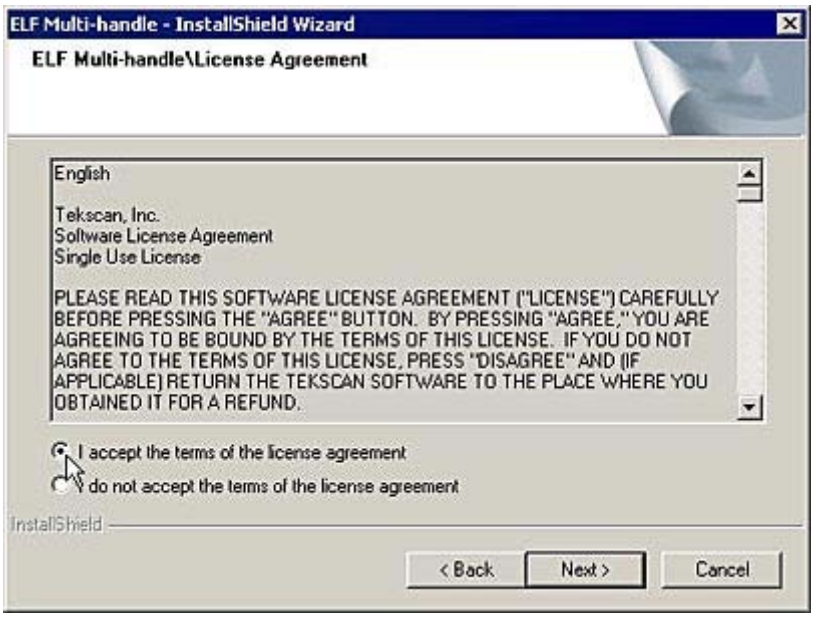
First, the InstallShield Wizard will prepare your machine for proper setup:


ELF Multi-handle - InstallShield Wizard
Preparing Setup
Please wait while the InstallShield Wizard prepares the setup.
ELF Multi-handle Setup is preparing the InstallShield Wizard, which will guide you through the rest of the setup process. Please wait.
InstallShield
Cancel

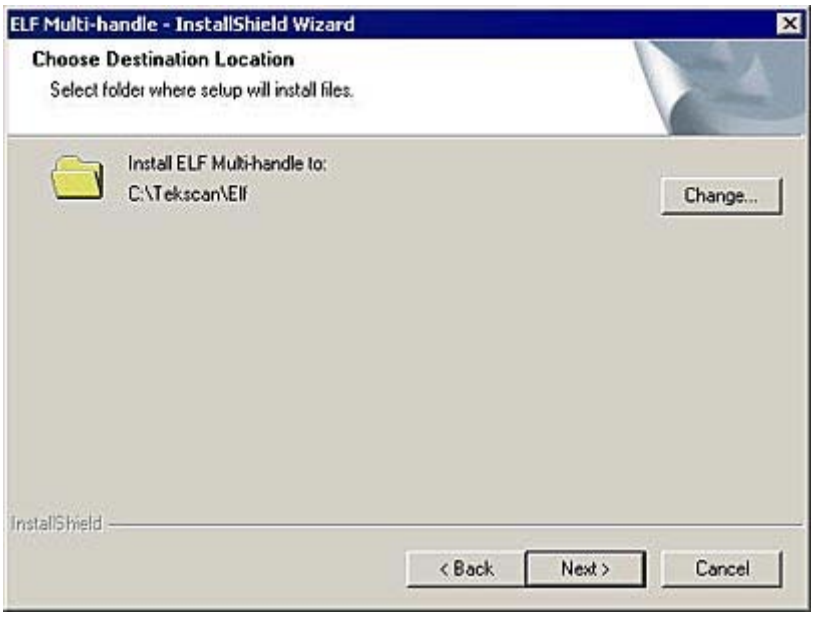
The next screen you will see is the Welcome screen. Click **Next** to continue with the Setup.


ELF Multi-handle - InstallShield Wizard
Welcome to the InstallShield Wizard for ELF Multi-handle
The InstallShield® Wizard will install ELF Multi-handle on your computer. To continue, click Next.
< Back
Next >
Cancel

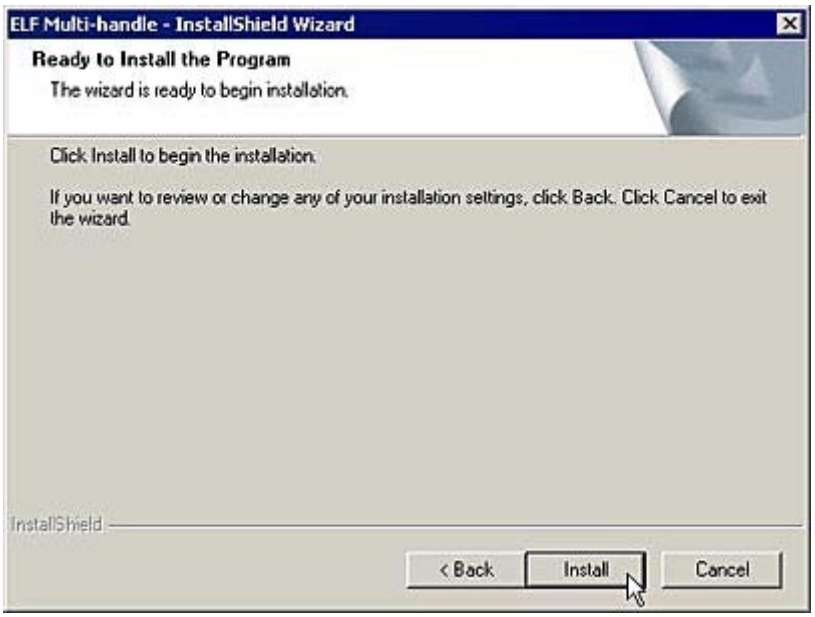
You will be taken to the License Agreement page. When you have read the License and agree to the terms, click the **Next** button to continue with your installation.


ELF Multi-handle - InstallShield Wizard
ELF Multi-handle\License Agreement
English
Tekscan, Inc.
Software License Agreement
Single Use License
PLEASE READ THIS SOFTWARE LICENSE AGREEMENT ("LICENSE") CAREFULLY BEFORE PRESSING THE "AGREE" BUTTON. BY PRESSING "AGREE," YOU ARE AGREEING TO BE BOUND BY THE TERMS OF THIS LICENSE. IF YOU DO NOT AGREE TO THE TERMS OF THIS LICENSE, PRESS "DISAGREE" AND (IF APPLICABLE) RETURN THE TEKSCAN SOFTWARE TO THE PLACE WHERE YOU OBTAINED IT FOR A REFUND.
I accept the terms of the license agreement
I do not accept the terms of the license agreement
InstallShield
< Back
Next >
Cancel

Next, the installation program will copy the necessary files to your computer. The default location is **C:\Tekscan\Elf**, however, you can change this location by clicking the **Change** button and designating a destination of your choice on your computer's hard drive.

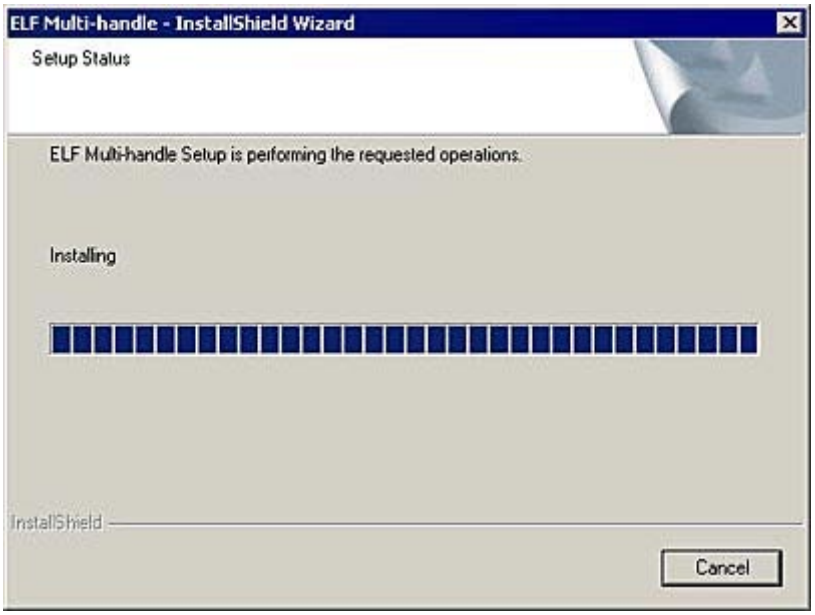


At this point, your computer has the necessary information to proceed with the installation of your ***ELF*** program. Click the **Install** button to begin installing the program on your computer.

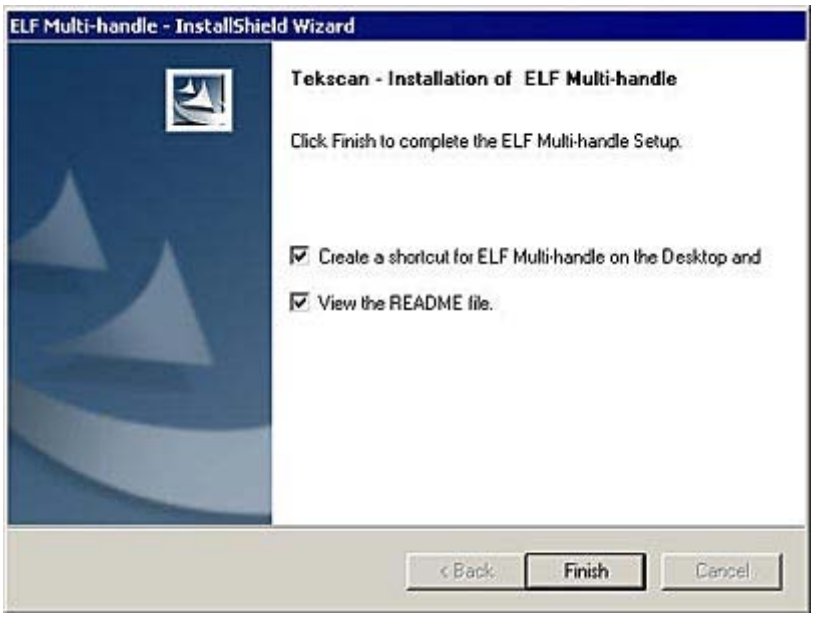

ELF Multi-handle - InstallShield Wizard
Ready to Install the Program
The wizard is ready to begin installation.
Click Install to begin the installation.
If you want to review or change any of your installation settings, click Back. Click Cancel to exit the wizard.
InstallShield
< Back
Install
Cancel

A progress bar will indicate the program is being successfully installed.

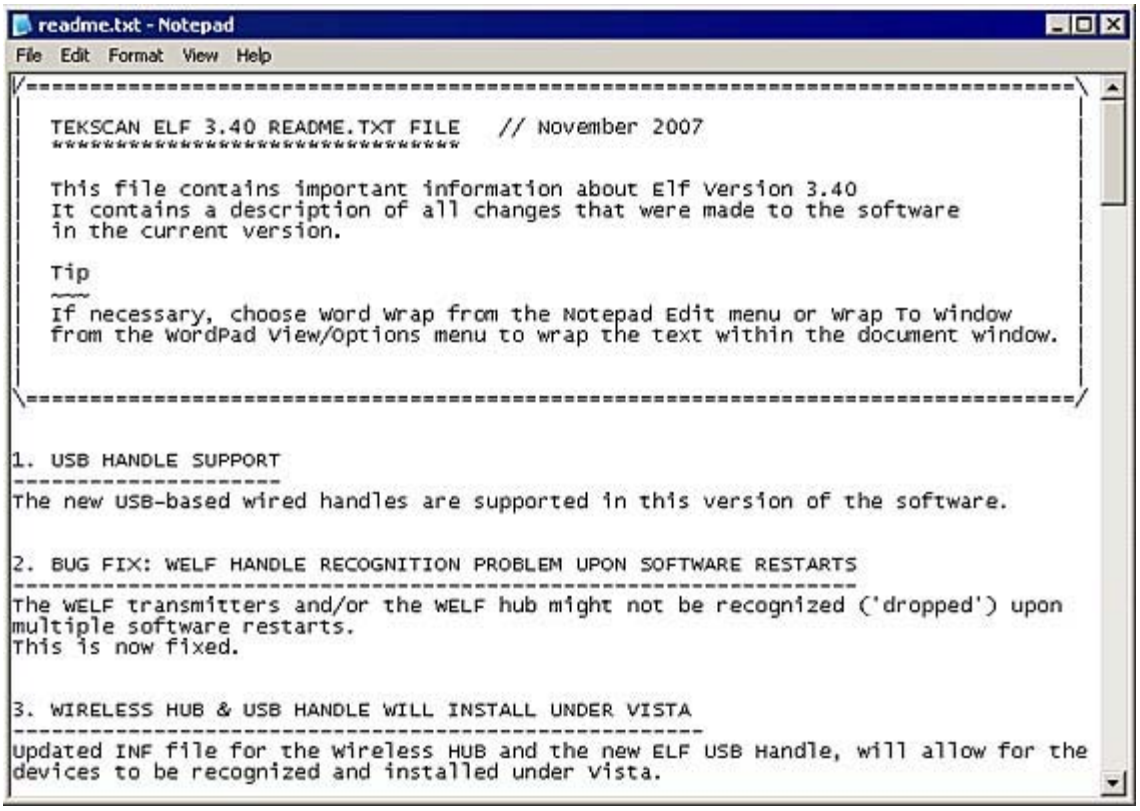
Note: If, at any time prior to this screen you wish to stop the installation process, you can click the Cancel button.



The next screen that will appear offers you the options to place a shortcut icon on your desktop and view the **README** file.


ELF Multi-handle - InstallShield Wizard
Tekscan - Installation of ELF Multi-handle
Click Finish to complete the ELF Multi-handle Setup.
Create a shortcut for ELF Multi-handle on the Desktop and
View the README file.
< Back
Finish
Cancel

If you elect to view the **README** file, it will open in a MS Notepad window, where you can read about new and updated information regarding the latest release of the ***ELF*** software.


readme.txt - Notepad
File Edit Format View Help
TEKSCAN ELF 3.40 README.TXT FILE // November 2007
This file contains important information about Elf Version 3.40
It contains a description of all changes that were made to the software
in the current version.
Tip
If necessary, choose Word Wrap from the Notepad Edit menu or Wrap To Window
from the WordPad View/Options menu to wrap the text within the document window.
1. USB HANDLE SUPPORT
The new USB-based wired handles are supported in this version of the software.
2. BUG FIX: WELF HANDLE RECOGNITION PROBLEM UPON SOFTWARE RESTARTS
The WELF transmitters and/or the WELF hub might not be recognized ('dropped') upon
multiple software restarts.
This is now fixed.
3. WIRELESS HUB & USB HANDLE WILL INSTALL UNDER VISTA
Updated INF file for the Wireless HUB and the new ELF USB Handle, will allow for the
devices to be recognized and installed under Vista.

When the installation is completed, you will need to restart your system. Click the **Finish** button, and your system will be automatically rebooted. You cannot start the ***ELF*** software without first restarting.

ELF Multi-handle - InstallShield Wizard
Tekscan - Installation of ELF Multi-handle
Click Finish to exit ELF Multi-handle setup.
Yes, I want to restart my computer now.
No, I will restart my computer later.
Remove any disks from their drives, and then click Finish to complete setup.
< Back
Finish
Cancel

The ***ELF*** splash screen will be shown (below). This indicates the ***ELF*** software is successfully loaded on your machine.

ELF
Economical Load & Force system
Data Acquisition System
from Tekscan, Inc.
Tekscan, Inc. is an ISO 9001 registered company.

The installation process is now complete. When your computer is rebooted, the application can then be launched by clicking on the **Start** button at the bottom left of the screen, and selecting **Programs -> Tekscan -> ELF**.

You can also launch the program by double-clicking the **ELF** icon on your desktop (provided you opted to place an icon on your desktop during the installation procedure).

HARDWARE INSTALLATION

The ***ELF*** system hardware includes the Sensor Handle(s), ***ELF*** software, and the flexiForce sensor(s). If you are using the Multi-Handle ***ELF*** system, refer to the instructions included. Connect one ***ELF*** handle to each COM port you wish to use during testing.

The image below displays the USB connection for the ELF system:

Multi-Handle system with handles connected to the USB hub

1. Connect the Handle's USB connector to an available USB port on the PC or laptop. Or, in a multi-handle configuration, you may choose to use a USB hub to connect your Handles. Connect the Hub to the USB port of the PC or laptop. Then connect each USB handle to the USB ports on the Hub.

2. Insert the sensor into the Handle. To do this, ensure that the "UP" printed on the sensor is correctly oriented (on the same side as the blue button on the handle), and then press down the blue button. Slide the sensor tab into the slot until it reaches its mechanical stop, and release the blue button.

   Do not force the sensor if it will not slide into the handle easily. If the sensor will not slide in easily, check that there is nothing inside the handle blocking the sensor, and check that the end of the sensor is not bent or folded.

If the software has been installed, and is running, when the sensor is correctly inserted, an audible beep will be heard, and the "Sensor OK" icon on the Toolbar will be a green square; otherwise it will be "grayed out".

Note: Follow Static control procedures when handling the sensor while it is in use.

USB ELF SYSTEM SPECIFICATIONS

The following table outlines the specifications for the USB ELF system:

COMMUNICATION/DATA ACQUISITION	
COMMUNICATION PROTOCOL TO HOST COMPUTER	USB 2.0
SCAN SPEED	Up to 960 Hz.
DIGITAL PRESSURE RESOLUTION	8 BIT
ELECTRICAL	
POWER SOURCE:	USB Powered
POWER CONSUMPTION:	25mA MAX at 5V
MECHANICAL	
USB CABLE (non-detachable)	
LENGTH ft (mm)	10 (3048) - Standard
ELF ENCLOSURE	
SIZE LxWxH in (mm)	2.75 x 1.25 x 0.5in (69.85 x 31.75 x 12.7mm)
WEIGHT lbs (kgs) (w/cable)	3.2 Oz (90g)

AMBIENT OPERATING CONDITIONS	
TEMPERATURE: ^{o}F (^{o}C)	14 to 131 (-10 to 55) Prolonged use at high Temperatures should be avoided
HUMIDITY: %	0 to 90 (non condensing)
PRESSURE: psi (kPa)	1.7 to 14.7 (11.6 to 101.3) (sea level to 50,000 ft)
STORAGE AND TRANSPORT CONDITIONS	
TEMPERATURE: ^{o}F (^{o}C)	-4 to 131 (-20 to 55) Short-Term 41 to 104 (5 to 40) Long-Term
HUMIDITY: %	0 to 90 (non condensing)
PRESSURE: psi (kPa)	1.7 to 14.7 (11.6 to 101.3) (sea level to 50,000 ft)

OVERVIEW

This section outlines the Various Hardware and Software components that ship with your system.

SENSORS

The ***FlexiForce*** sensor is an ultra-thin and flexible printed circuit. Sensors are available in three full-scale force ranges: ***Low*** (25 lbf), ***Medium*** (150 lbf), and ***High*** (1000 lbf). The "active sensing area" is a 0.375" diameter circle at the end of the sensor. The sensors are constructed of two layers of substrate, such as a polyester film. On each layer, a conductive material (silver) is applied, followed by a layer of pressure-sensitive ink. Adhesive is then used to laminate the two layers of substrate together to form the sensor. The "active sensing area" is defined by the silver circle on top of the pressure sensitive ink. Silver extends from the sensing area to the connectors at the other end of the sensor, forming the conductive leads.

The sensor acts as a variable resistor in an electrical circuit. When the sensor is unloaded, its resistance is very high (greater than 5 Meg-ohm); when a force is applied to the sensor, the resistance decreases. This resistance is read, and an 8-bit analog-to-digital converter changes the output to a digital value in the range of 0 to 255.

There are three types of FlexiForce sensors available, as outlined in the chart below:

Sensor	*System*	*Specifications*
A-201	For use with your own electronics	Force ranges: A201-1 (0-1 lb), A201-25 (0-25 lbs) and A201-100 (0-1000 lbs)
B-201	ELF, Multi-Handle ELF, or High-Speed ELF	Force ranges: Low (0-25 lb), Medium (0-150 lb) and High (0-1000 lb)
WB-201	Wireless ELF or Wireless Multi-Handle ELF	Force ranges: Low (0-25 lb), Medium (0-150 lb) and High (0-1000 lb)

SENSOR HANDLE

The sensor's tab is placed into the sensor handle. The handle gathers data from the sensor, processes it, and sends it to your computer through a USB connection.

Note: Our previous systems shipped with Serial handles. It is not recommended to use both the Serial ELF and USB ELF handles simultaneously.

SCREEN DISPLAY

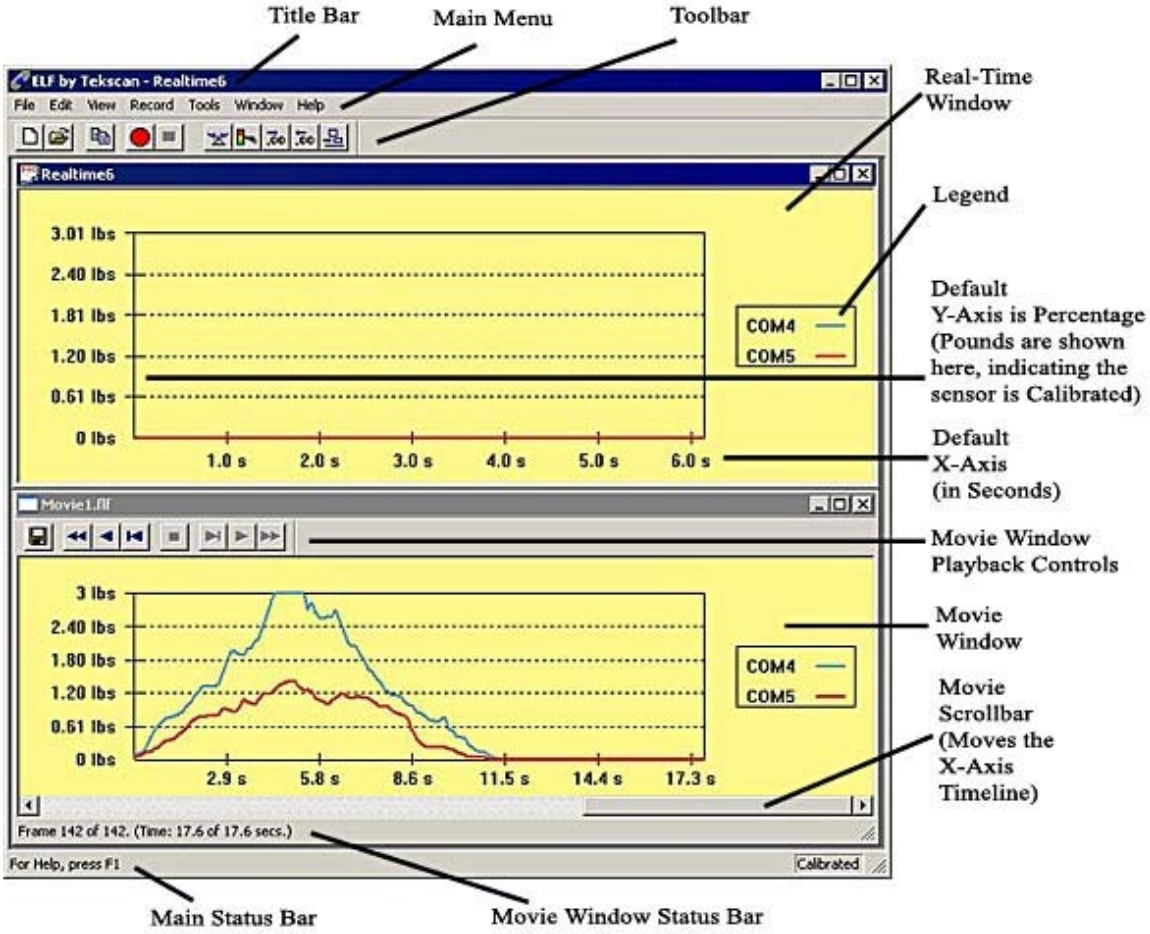
This section is a comprehensive look at the ***ELF*** screen display. Each component of the display, as well as each Main Menu option, will be described in detail.

Note: Familiarity with MS Windows is assumed, so menu items that have the same function in standard Windows applications are not described in this manual.

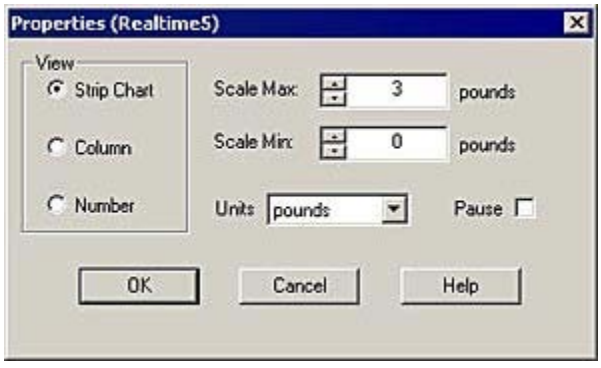
Main Window

When you initiate the ***ELF*** software program, the **Main Window** is displayed on your computer screen. The Main Window consists of the **Menu Bar**, **Tool Bar**, and **Main Status Bar**, and may contain one or more **Real-time** or **Movie Windows**. The window that is selected is considered the active window. Only one window can be active at one time, and the title bars of the other windows will be grayed out. The Main Window, and its components, are shown in the figure below.

NOTE that the figure below shows a Multi-Handle ELF system with two handles recording data.



Real-Time Window: displays the load applied to the sensor as it is happening (in real-time). The *Properties* of this display can be changed in the **File** pull-down menu, or by clicking the right mouse button.



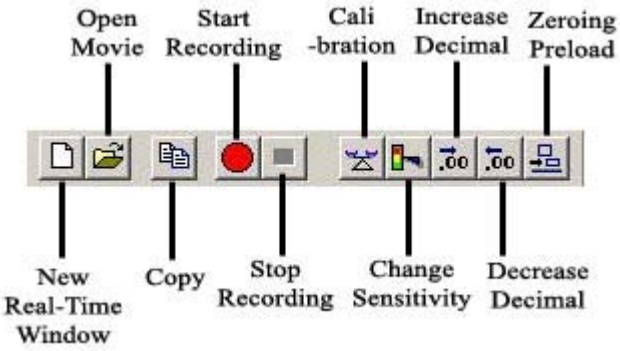
Menu Bar: provides drop-down menus used to control the program. It is located at the top of the Main Window.

The Main Menu as it appears when focus is on a Movie Window:

The Main Menu as it appears when focus is on a Real-time Window:

Note: for more information, see the Main Menu section.

Toolbar: provides some of the same options as the Menu Bar, but with icons replacing drop-down menus. It is located directly below the Menu Bar, at the top of the Main Window. Note that not all items in the Menu Bar have a corresponding icon on the Toolbar.



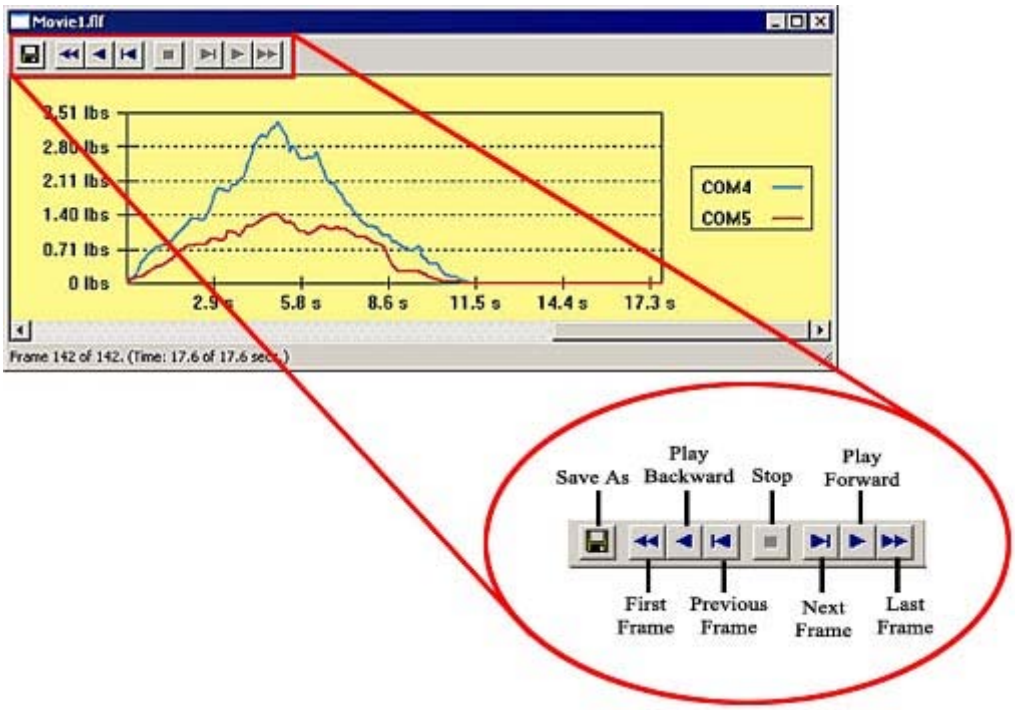
Two icons on the Toolbar do not have corresponding pull-down menus. They are the **Increase Decimal** and **Decrease Decimal** buttons. When sensors have been calibrated, units of force will be shown. Clicking these buttons will either increase or decrease the number of decimal places displayed by the software.

Main Status Bar: will either say "For Help, Press F1," or will give a description of whichever Toolbar icon is under the cursor. The Main Status Bar is located at the bottom of the Main Window.

Movie Window

The **Movie Window** displays a previously recorded movie. It consists of the display area, a scroll bar, the **Movie Toolbar** with playback controls, and the **Movie Window Status Bar**.

Movie Tool Bar: This bar is located at the top of the **Movie Window**, and consists of the movie playback icons and the **Save As** icon.



- The **Save As** icon allows you to save the current movie file under a different filename.

The **Playback** icons control the movie playback functions. They are (from left to right in the Movie Toolbar):

- **First Frame:** Positions the recording at the beginning (first frame).
- **Play Backward:** Plays the recording in reverse.
- **Previous Frame:** Plays the recording in reverse one frame each time it is clicked.
- **Stop:** Stops playback.
- **Next Frame**: Plays the recording forward one frame each time it is clicked.
- **Play Forward:** Plays the recording forward.
- **Last Frame:** Positions the recording at the end (last frame)

- **Movie Window Status Bar** is located at the bottom of the Movie Window, and displays the "Frame count" (the current frame number vs. the total number in the movie). Directly above this status bar is a "scroll bar", which can be used to move to any point (frame) in the movie.

THE MAIN MENU

The Main Menu

The **Main Menu** contains important commands you use to perform functions within the software. Some menu commands can be found directly in the toolbar, however, not all commands found under the menu are located on the toolbar. For this reason, it is important to become acquainted with the commands found under each menu. This section provides a thorough description of each command and dialog box found under these menus.

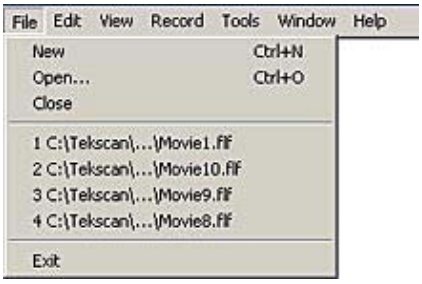
It is important to note that the Main Menu changes, depending where your "focus" lies. The reason for this difference is because there are some commands that can only be accessed from a Movie Window, and others from a Real-time Window. For example, if you have two windows open, one a Real-time Window, and the other a Movie Window, the Main Menu will contain a different set of submenus and commands. The following display shows the difference between the two Main Menus:

The Main Menu as it appears when focus is on a Movie Window:

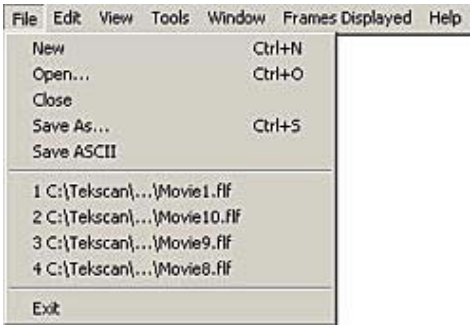
The Main Menu as it appears when focus is on a Real-time Window:

File Menu

File Menu when focus is on a Real-time Window:



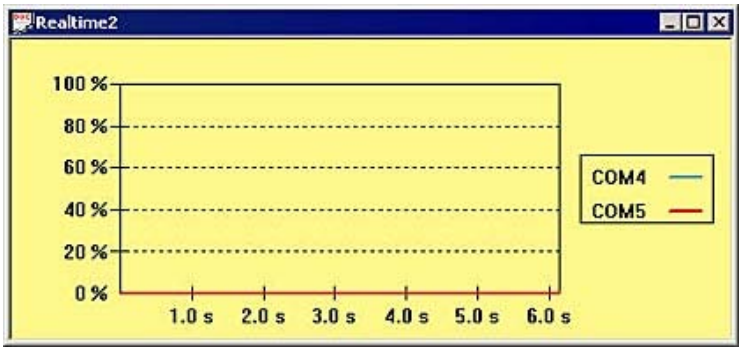
File Menu when focus is on a Movie Window:



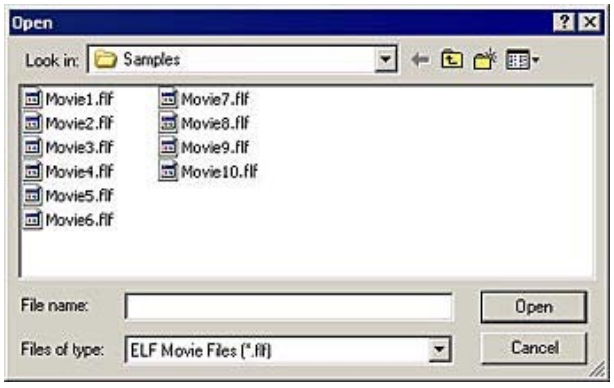
New: opens a new Real-time Window, in addition to any other Real-time or Movie windows that are currently open. The new Real-time Window becomes the active window when it is opened. If more than one Real-time Window is open, the force data will be displayed in all windows, in unison. If the sensor has already been calibrated, this calibration will also apply to the new Real-time Window.

Before your Real-time Window opens, the *Select Button* dialog box is displayed. Handles connected to your system are listed as "COM 4", "COM 5", etc. Select the handles you wish to have displayed in your Real-time Window by placing a checkmark next to the COM port(s), and then click the **OK** button.

You are then taken to a new Real-time Window:

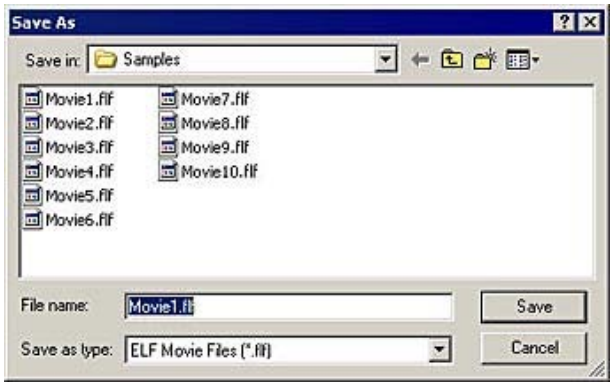


Open: displays the Open dialog box, which allows you to open previously recorded movie files. Only ***ELF*** movie files, with the ***.flf** file extension, can be opened.

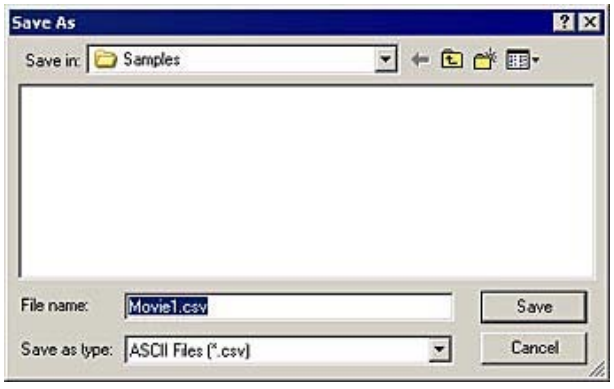


Close: causes the currently active Real-time or Movie Window to close. If a movie has been recorded, but not saved, the software gives the option of saving the movie file.

Save As: will save the current movie with the specific file name and location of your choice. ***ELF*** movie files must have the extension ***.flf**. Your system may limit filenames to eight characters. This menu item can be used to save a movie file under more than one filename.



Save As ASCII: saves the current Movie frame as an ASCII file, with the extension ***.csv**. Since these files are in **ASCII** (**comma separated value**) format, they can be imported into a spreadsheet program (e.g. MS Excel), or they can be opened in a text editor or word processing program (e.g. MS Word) in order to review and manipulate the data.



The force data is displayed as however many sensors you are measuring (1-16); the first is the elapsed time (in seconds), and the others are the applied force value (in the selected units) at that point (shown below). A data point is recorded each time the sensor data is read, so many more data points are recorded when "Fast Recording" is used (refer to the **Settings** menu item).

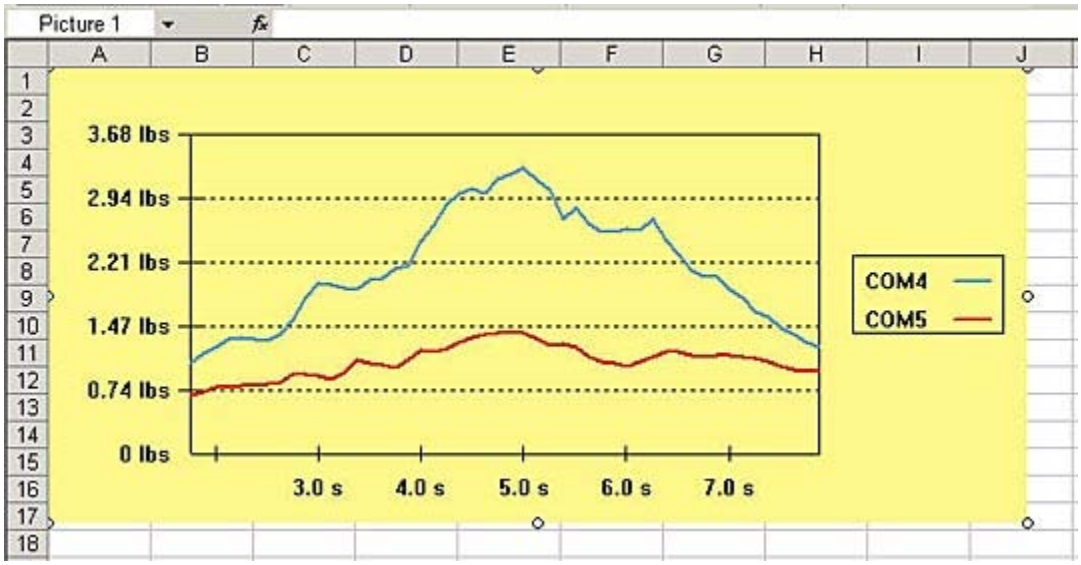
Seconds	Sensor 1	Sensor 2	Sensor 3
0	7.894737	5.263158	5.263158
0.125	44.73684	15.78947	5.263158
0.25	97.36842	92.10526	15.78947
0.375	134.2105	171.0526	73.68421

Edit Menu

Edit Menu (same when focus is on either a Real-time or Movie Window):

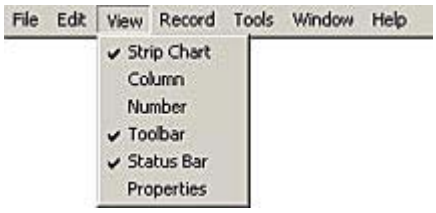
Copy: saves the current Real-time or Movie frame to the MS Windows clipboard. This data is saved in the clipboard as a graphic (bitmap) image of the current window. Once copied to the clipboard, this data can be pasted into other Windows applications by selecting **Edit -> Paste**.

The following image shows how the copy command can be used to import an image of the current window into MS Excel:



View Menu

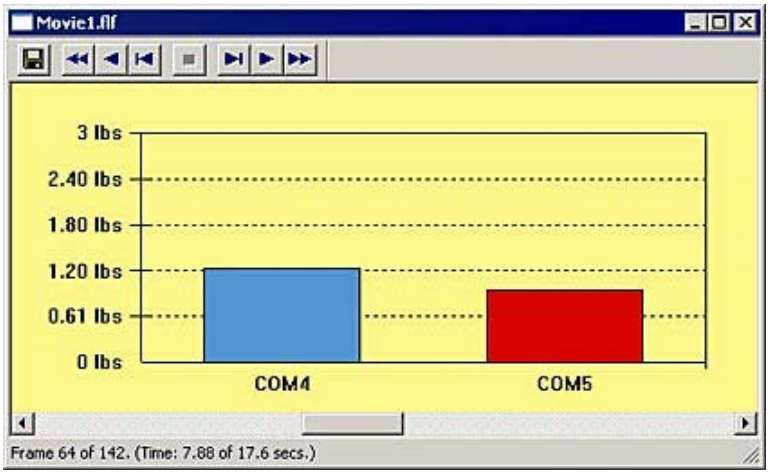
View Menu when focus is on a Real-time Window:



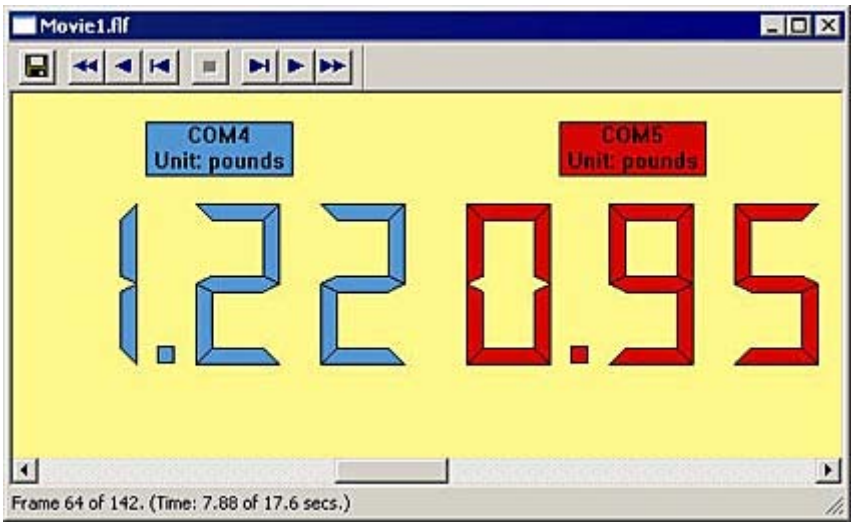
View Menu when focus is on a Movie Window:

Strip Chart: is the default display mode, where force value is displayed on the Y-Axis and elapsed time is displayed on the X-Axis.

Column: displays each COM port individually, with force value displayed on the Y-Axis. Each column is color-coded to indicate the individual COM ports. As time elapses, the columns indicate changes in force.



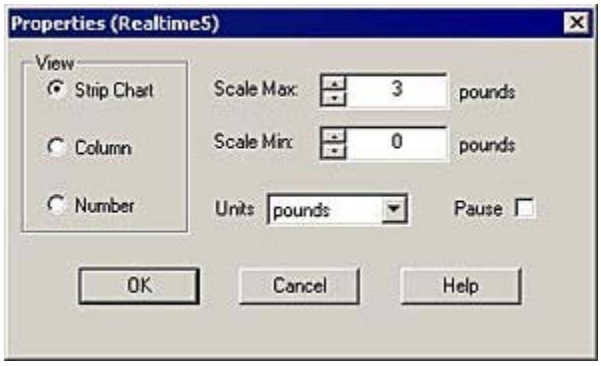
Number: displays each COM port as numerical values. Each numerical value is color coded to indicate the individual COM ports. As time elapses, the numbers change to indicate changes in force.



Toolbar: This item is used to display or hide the Movie and Main Toolbars. These toolbars can be toggled by clicking this menu item on and off. If a Real-time Window is active, this menu item affects the Main Toolbar. If a Movie window is active, this menu item affects the Movie Toolbar.

Status Bar: This item is used to display or hide the Movie and Main Status Bars. These status bars can be toggled by clicking this menu item on and off. If a Real-time window is active, this menu item affects the Main Status Bar. If a Movie window is active, this menu item affects the Movie Status Bar.

Properties: opens the *Properties* dialog box (shown following), which allows you to change how the data is displayed on the screen. Any changes made here will only affect the currently active Real-time or Movie Window. The *Properties* dialog box will also appear whenever you click the right mouse button over a Real-time or Movie Window.



Under *View*, you can select whether to display the force data as a Strip Chart, **Column**, or **Number**. Strip Chart shows the pressure data in the form of a chart, with elapsed time (in seconds) on the X-axis, and the selected units on the Y-axis. Column displays the data as a single column, with the force values on the Y-axis. Number displays the force data as a digital readout.

In the *Properties* dialog box, you may also change the **Scale Max**, **Scale Min**, and **Units**. Under Units, the display units (Percentage, Grams, Kilograms, Newtons, and Pound) are selected. **Scale Min** and **Scale Max** set the range of values that will be displayed. Certain default maximum and minimum values will be displayed for the selected units, and these values can be changed by clicking on the up and down arrows to the right of the numbers. Selecting **Pause** causes the current Real-time window to "freeze", or to ignore all commands. When this is selected, the word "Pause" will be added to the Title Bar of the window. Movie windows cannot be paused.

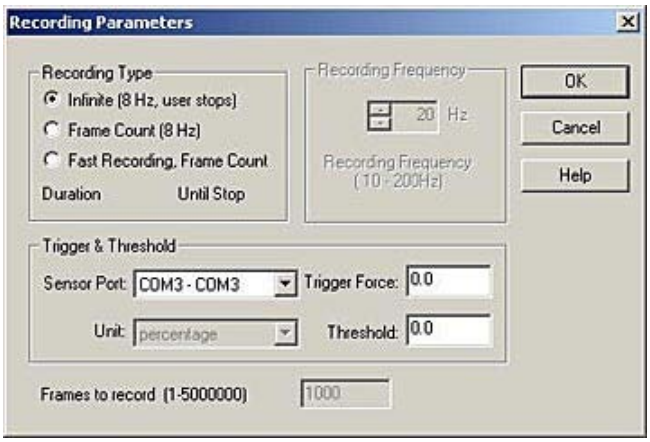
Record Menu

Record Menu (only available when focus is on a Real-time Window):

Start: is used to make a recording (movie). When this is selected, the software begins recording a movie of the current Real-time window data using the settings that have been selected (see the "Settings" menu item below). When data is being recorded, the *Recording* message will appear (shown at right), and the "Recording On" icon (on the Main Toolbar) will become active (the red circle will become "grayed out", and the square "Stop" button -- black color -- will become visible). If "Triggering" is in effect, and **Record** is selected, the "Waiting for Trigger" message will be displayed until the trigger force is reached. Movies created by the ***ELF*** system are stored as ***.flf** files.

Stop: will cause the software to stop recording the active Real-time Window, even if the correct number of movie frames (as selected in "Settings") have not yet been recorded.

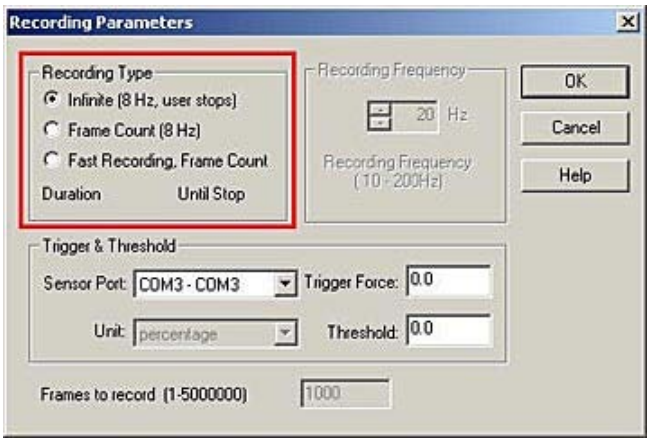
Settings: brings up the *Recording Parameters* dialog box, which allows you to change the current recording parameters. Under 'Recording Type,' there are three possibilities that may be selected.



Note: The Frequency, or acquisition rate, is measured in Hertz (Hz), which is the number of times per second the sensor output is read by the software.

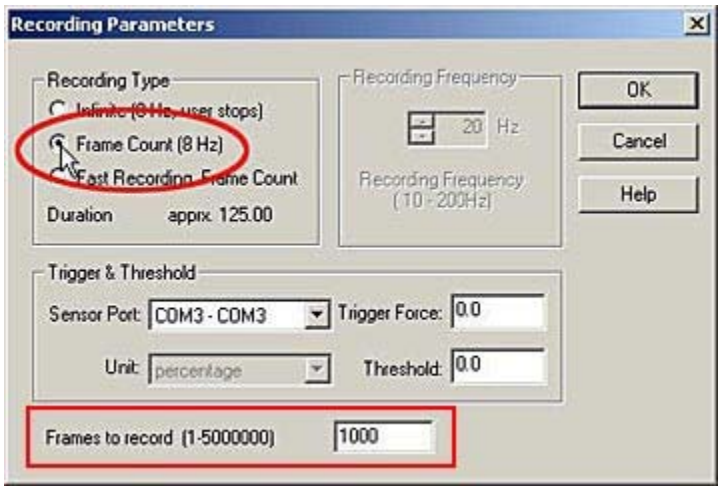
Standard ELF *Recording Parameters*

If you have purchased the standard ***ELF*** system, the software will record at a lower range of speeds, and your choices for 'Recording Types' include **Infinite**, **Frame Count** and **Fast Recording** (below).

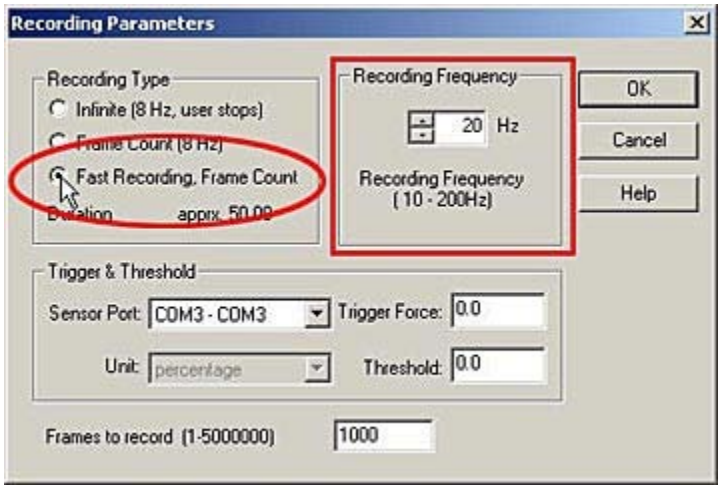


When **Infinite** is selected, recording will continue until **Stop** is selected (from the *Record* menu or by clicking its icon on the Toolbar).

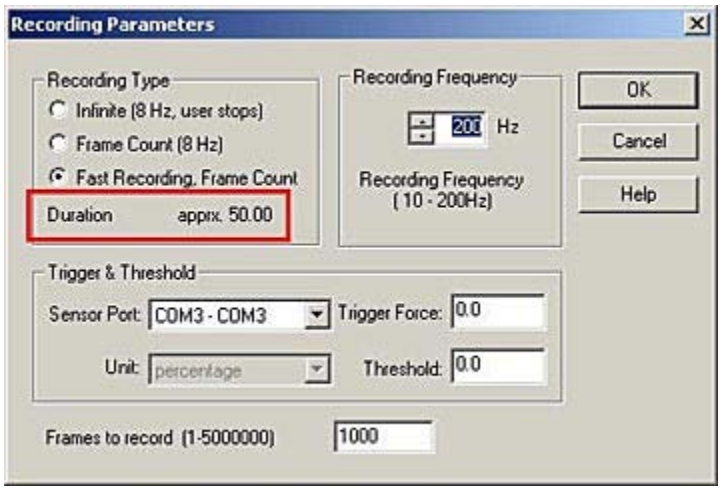
When **Frame Count** is selected, the number of "Frames to Record" may be entered at the bottom of the dialog box. The recording will stop when this number of frames has been recorded, regardless of the duration of the movie.



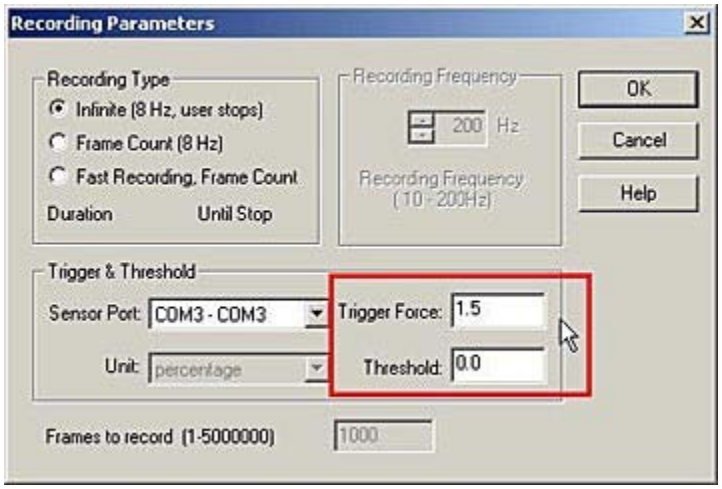
When **Fast Recording**, is selected, the "Frames to Record" may be entered, and the *Recording Frequency (Hz)* may be selected to the right. In "Fast Recording" applications, recordings can be obtained at user-defined frequencies between 10 and 200 Hz (standard system). For the High-Speed ELF system, frequencies as high as 5.7 kHz can be obtained.



The **Duration** is listed below the *Recording Type*, it will either say "Until Stop" if **Infinite** is selected, or the approximate duration (in seconds) the recording will take to complete if **Frame Count** is specified.

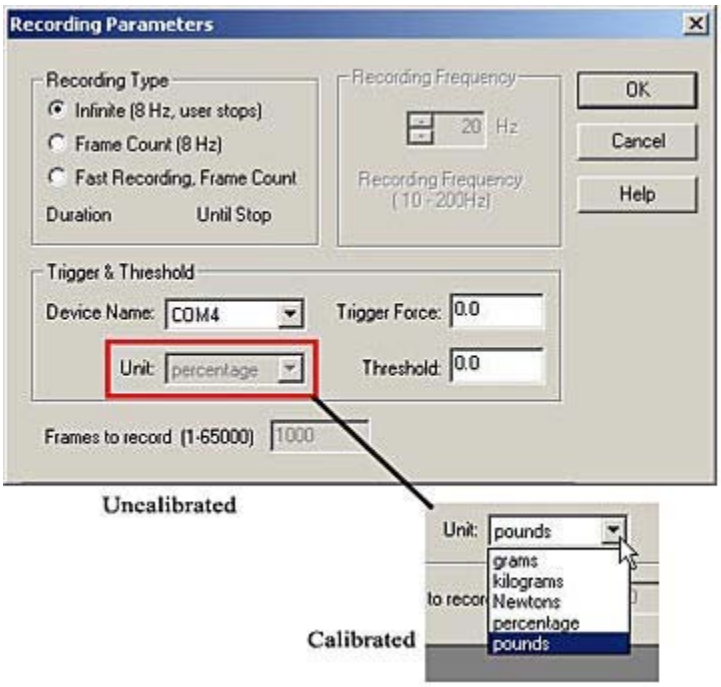


The *Recording Parameters* dialog box also allows you to "trigger" the start of a recording. If you enter a value in the **Trigger Force** field, and select the appropriate measurement units, recording will not begin until that force is exerted on the sensor. Enter a zero in this field to disable "triggering". Only one **Trigger Force** value may be entered, and will apply to all sensors being used for testing.



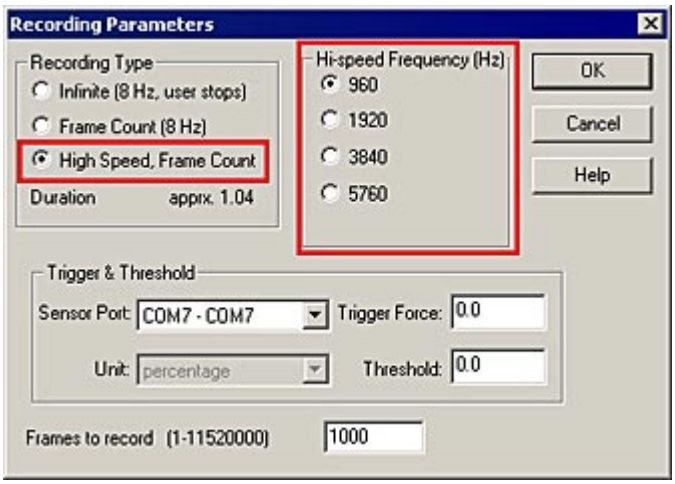
The **Threshold** may be set for each individual COM port, so that each sensor has a different threshold. This may be used in combination with the **Trigger Force** value to begin recording when force is exerted on a specific sensor.

Note: If no calibration has been performed, the only available units will be shown as a Percentage. If a calibration has been performed, you may select from a number of force units.



ELF *Hi-Speed Recording Parameters*

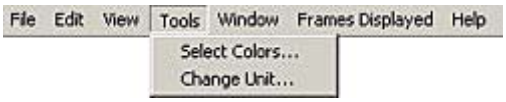
If you have purchased the ***ELF*** Hi-Speed system, the software will record at a higher range of speeds (up to 5760 Hz) , and your *Recording Parameters* dialog box will look slightly different. Your choices for Recording Type include **Infinite**, **Frame Count**, and **High Speed**.



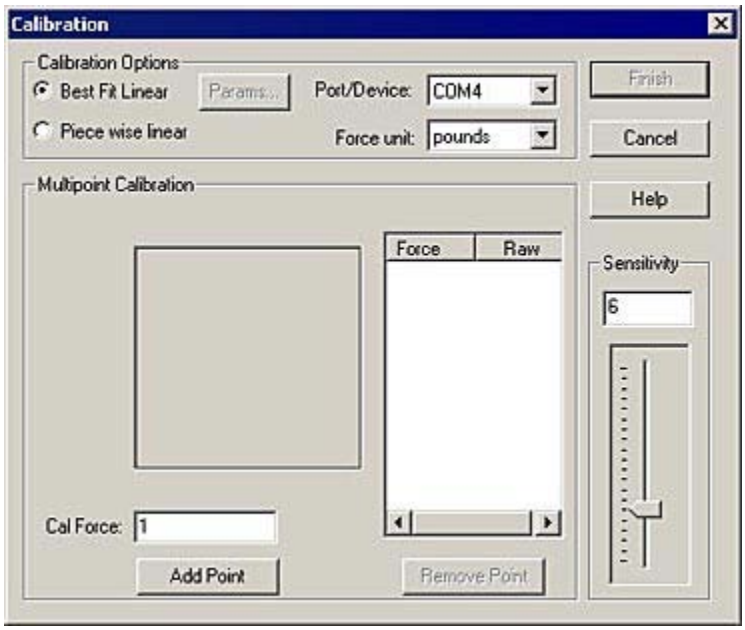
Tools Menu

Tools Menu when focus is on a Real-time Window:

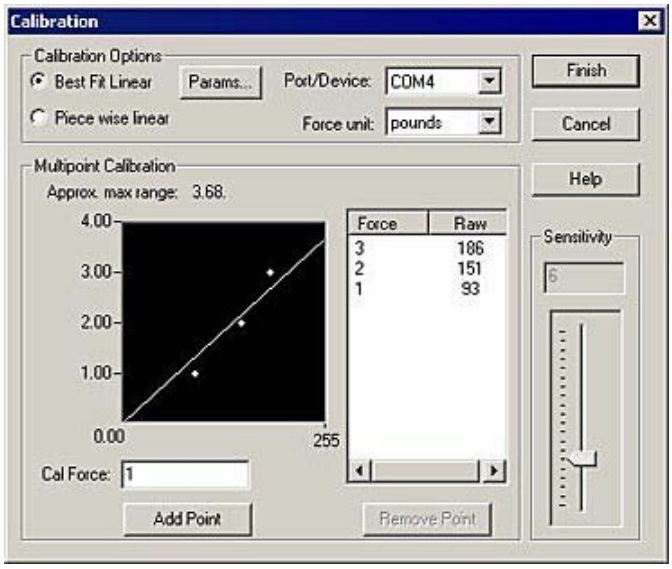
Tools Menu when focus is on a Movie Window:



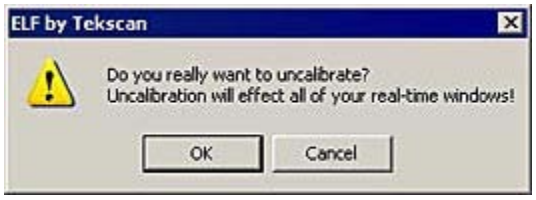
Calibrate: Opens the ***ELF** Calibration* dialog box, which enables you to calibrate the sensor and adjust the system sensitivity. Refer to the **Calibration** section for the complete calibration procedure and a thorough description of the process.



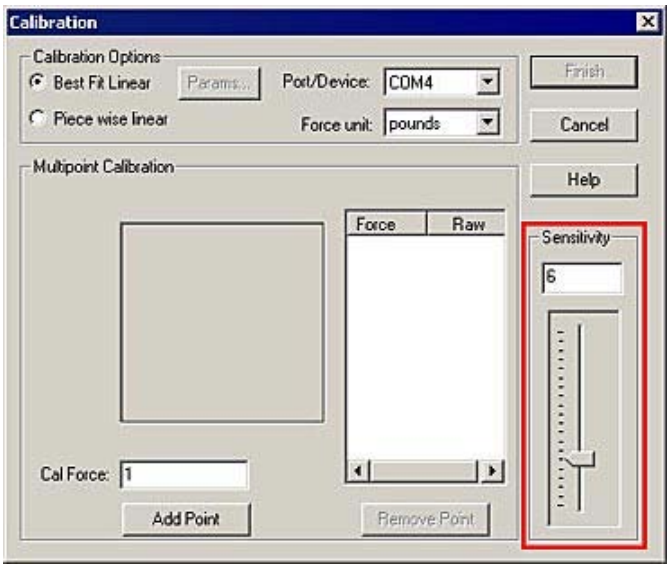
In the *Calibration* dialog box, the calibration load is entered under **Cal Force** by typing in the value, and selecting the appropriate units (Grams, Kilograms, Newtons, Pounds). Clicking the **OK** button will then begin the calibration process. The resulting calibration can be saved as a file by selecting **Save Calibration** under the same Tools menu.



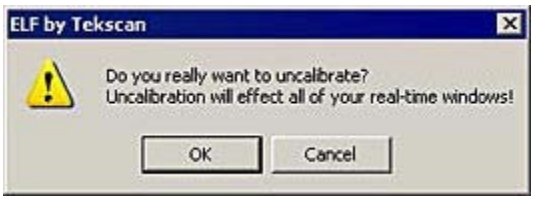
If you wish to recalibrate the sensor during the same testing session, you may either select **File -> New** to get a new Real-time Window, or select **Tools -> Uncalibrate** to reset the calibration of the current window. The current calibration will be saved between sessions, unless **Uncalibrate** is selected. A dialog prompt will open asking if you are sure you want to uncalibrate. It is usually a good idea to save your calibration file before you uncalibrate, as there is no way to retrieve your calibration once you use this command and click **OK** in the message prompt below.



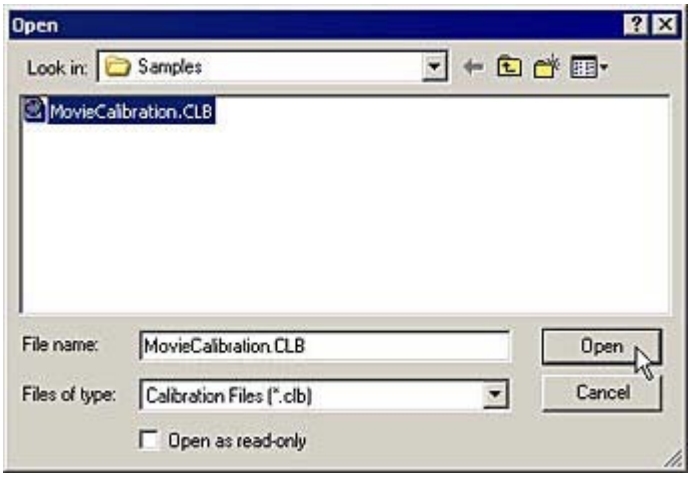
Sensitivity (or "Adjustable Gain") is also adjusted in the *Calibration* dialog box. The Sensitivity should be adjusted whenever necessary to keep the force display in a usable range. Sensitivity settings are saved between sessions, and are included with calibration files. The sensitivity adjustment is described in detail in the Calibration Procedure.



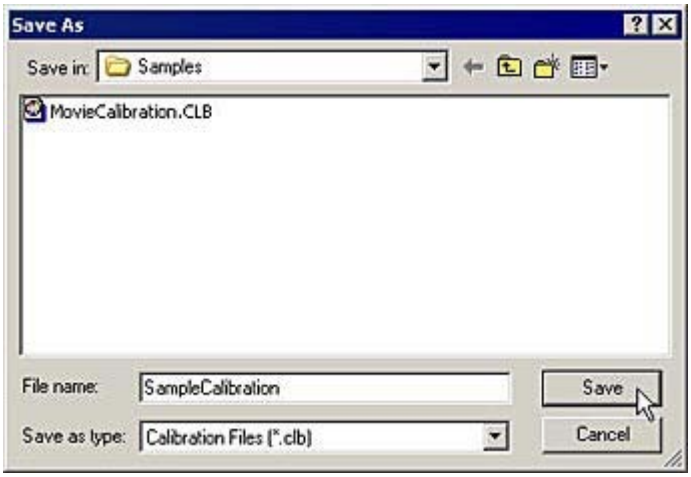
Uncalibrate: This option removes the sensor's calibration data. When this item is selected, a dialog box will appear, giving the option of canceling the Uncalibrate operation. Uncalibrate does not affect the Sensitivity setting.



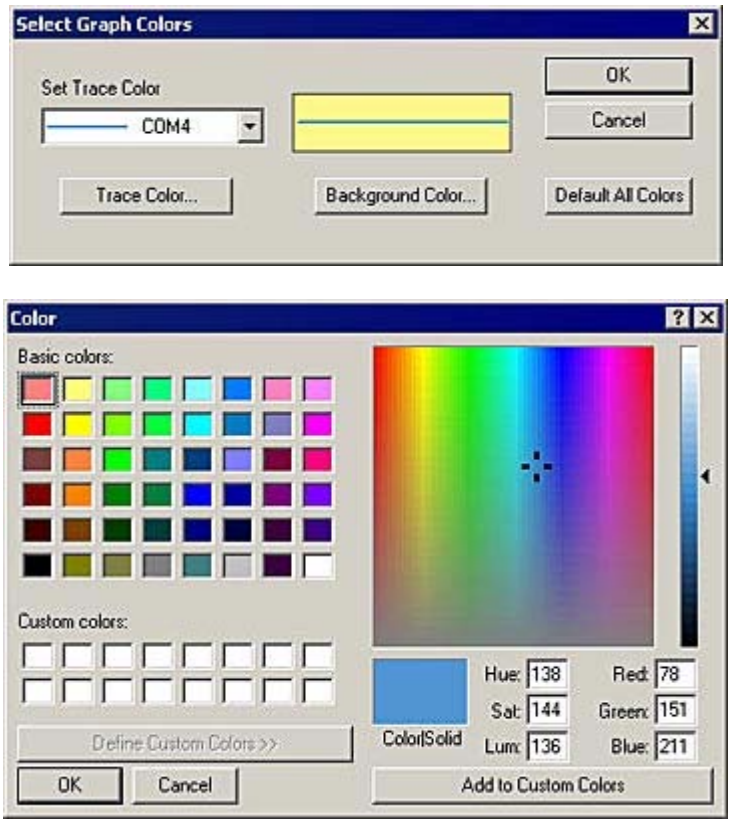
Load Calibration: allows you to use the calibration data from a previously-saved file for your current Real-time Window. When this item is selected, an *Open* dialog box appears, and the calibration file can be located and opened. Only ***ELF*** calibration files (extension ***.clb**) can be loaded. The Sensitivity setting that was saved with the calibration file will also be loaded.



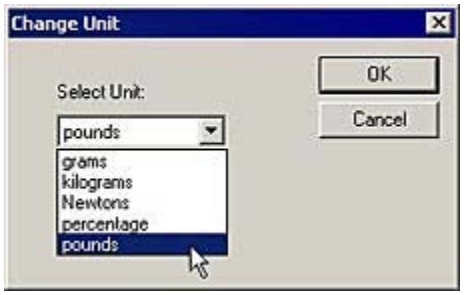
Save Calibration: allows you to save your current calibration as a file for future use. When this item is selected, a *Save As* dialog box appears, and the calibration file can be saved with the specific file name and location of your choice. Calibration files must have the extension ***.clb**. The Sensitivity setting is also saved with the calibration file.



Select Colors: allows you to customize the background color, as well as the trace color for each ***ELF*** device in your View windows. When this item is selected, the "Select Graph Colors" dialog box appears. By clicking on either **Trace Color** or **Background Color**, an MS Windows color palette becomes available, and you can select one of the standard colors or create your own custom color for each of the COM ports (sensors). The color you choose will be used for all Movie and Real-time Windows, and will be set as the default color. To restore the original color, select the **Default All Colors** button.

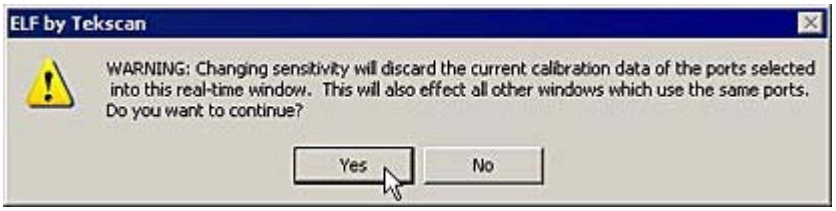


Change Unit: This feature allows you to quickly change the force units displayed in all windows. To use this feature, however, you must have performed a calibration. Otherwise, all force will be displayed as "raw values".

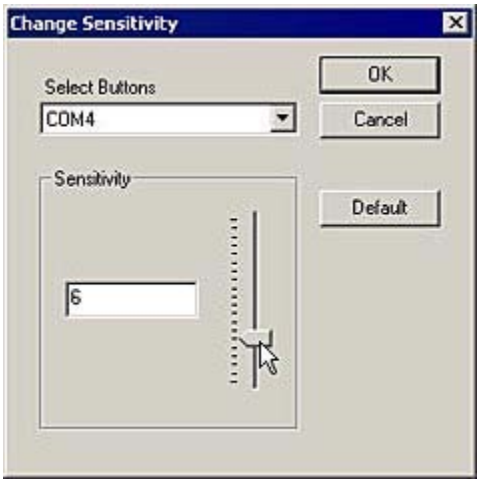


Change Sensitivity: This feature opens the *Change Sensitivity* Dialog box (below). You may adjust the sensitivity for each sensor/COM port. Use the drop down **Select Buttons** field to select the COM port. Then drag the slider up and down until you are satisfied. Adjust as many buttons as you like. When you are satisfied, click **OK**. To return the system to the original sensitivity settings, click the **Default** button.

When you change the Sensitivity, a message will open up explaining that your calibration will be discarded (if you have Calibrated the sensor). If you want to continue, click **Yes**.


ELF by Tekscan
WARNING: Changing sensitivity will discard the current calibration data of the ports selected into this real-time window. This will also effect all other windows which use the same ports. Do you want to continue?
Yes
No

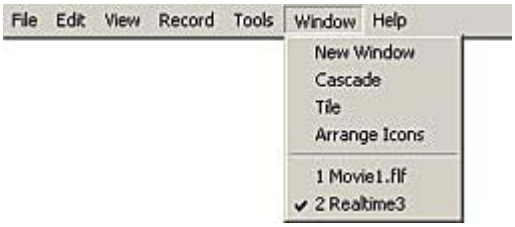
You then have the option to change the Sensitivity of the sensor.



Zeroing Preload: This feature modifies the calibrated data to correct for residual pressure (referred to as the "Offset Load") on the sensor at zero load. This operation is useful if the sensor is under some load for the entire duration of the recording, or if the sensor must be secured in place by hardware which would cause load to be detected by the sensor. The raw data is not affected by the Zeroing Preload function, but an extra calculation is performed when converting the raw data to calibrated data. If the sensor is reading raw pressure, it is set at zero raw before the calibration scale factor is applied. Zeroing Preload is recommended only for single point calibration and may increase error when using a multi-point calibration.

Window Menu

Window Menu (same when focus is on either a Real-time or Movie Window):



New Window: opens a copy of the currently active Real-time or Movie Window. A number will be added to the title of the new window, to show that it is a copy. For example, if **Movie1.flf** is open, and the **New Window** menu item is selected, the new window's title bar would read "Movie1.flf:2." This menu item is especially useful for opening multiple copies of a Movie window, so you can play them back individually, or with different view properties. Copies of Real-time Windows will display the sensor data in unison with the original window.

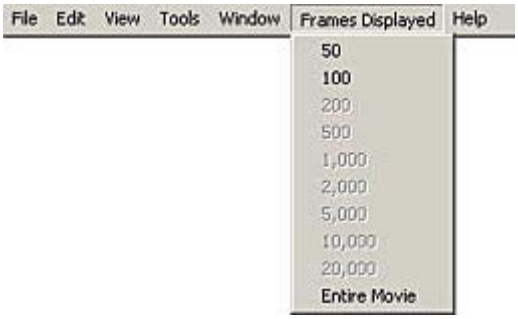
Cascade: arranges multiple windows in an overlapped fashion.

Tile: arranges multiple windows in an overlapped fashion, either vertically or horizontally.

Arrange Icons: arranges the icons for minimized windows at the bottom of the main window.

Frames Displayed Menu

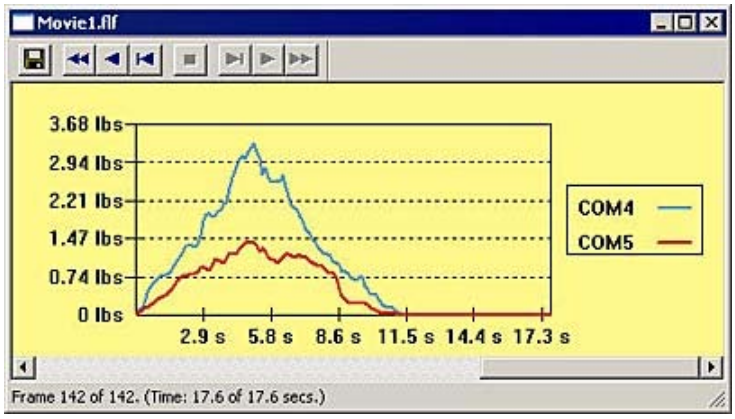
Frames Displayed Menu (only available when focus is on a Movie Window):



The Frames Displayed Menu provides various display options for the amount of frames shown within the Movie Window (along the X-axis). In addition, you can opt to view the **Entire Movie** within the window's display area.

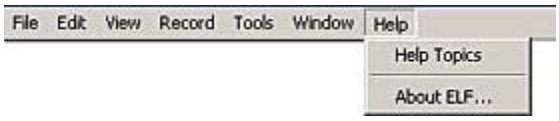
The following image at right shows **50** frames within a movie.

The following image shows the same movie, but this time with the **Entire Movie** option selected:



Help Menu

Help Menu (same when focus is on either a Real-time or Movie Window):



Help Topics: opens the help file associated with the Multi-Channel ***ELF*** software.

About ELF: opens the *About ELF* dialog box, which displays the software and hardware (device) version numbers for your ***ELF*** system, and gives you information on how to contact Tekscan (shown below).

SENSOR LOADING CONSIDERATIONS

The following general sensor loading guidelines can be applied to most applications, and will help you achieve the most accurate results from your tests. It is important that you read the ***Sensor Performance Characteristics*** section for further information on how to get the most accurate results from your sensor readings.

SENSOR LOADING

The entire sensing area of the ***FlexiForce*** sensor is treated as a single contact point. For this reason, the applied load should be distributed evenly across the sensing area to ensure accurate and repeatable force readings. Readings may vary slightly if the load distribution changes over the sensing area.

Note that the sensing area is the silver circle on the top of the sensor only.

It is also important that the sensor be loaded consistently, or in the same way each time.

If the footprint of the applied load is smaller than the sensing area, the load should not be placed near the edges of the sensing area, to ensure an even load distribution. It is also important to ensure that the sensing area is the entire load path, and that the load is not supported by the area outside of the sensing area.

If the footprint of the applied load is larger than the sensing area, it may be necessary to use a "puck". A puck is a piece of rigid material (smaller than the sensing area) that is placed on the sensing area to ensure that the entire load path goes through this area. The puck must not touch any of the edges of the sensing area, or these edges may support some of the load and give an erroneous reading.

The ***FlexiForce*** sensor reads forces that are perpendicular to the sensor plane. Applications that impart "shear" forces could reduce the life of the sensor. If the application will place a "shear" force on the sensor, it should be protected by covering it with a more resilient material.

If it is necessary to mount the sensor to a surface, it is recommended that you use tape, when possible. Adhesives may also be used, but make sure that the adhesive will not degrade the substrate (polyester) material of the sensor before using it in an application. Adhesives should not be applied to the sensing area; however, if it is necessary, ensure that the adhesive is spread evenly. Otherwise, any high spots may appear as load on the sensor.

SATURATION

The **Saturation** force is the point at which device output no longer varies with applied force. The saturation force of each sensor is based on the maximum recommended force specified by Tekscan, which is printed on system packaging or the actual sensor, along with the "Sensitivity".

Sensors are available in three force ranges (**Low**, **Medium**, and **High**), which have specified maximum forces of 25, 150, and 1000 lbf, respectively. The sensor's effective force range (up to the specified maximum) can be altered by adjusting the system sensitivity (refer to the Calibration section). Decreasing the sensitivity setting (1 to 20 possible) will increase the force range (displayed as "Approx Max Range"), and "saturation" force, of the sensor, and vice versa.

It is essential that the sensor(s) do not become saturated during testing.

CONDITIONING SENSORS

Exercising, or **Conditioning** a sensor before calibration and testing is essential in achieving accurate results from your ***ELF*** system. It helps to lessen the effects of *drift* and *hysteresis*. Conditioning is required for new sensors, and for sensors that have not been used for a length of time.

To condition a sensor, place 110% of the test weight on the sensor, allow the sensor to stabilize, and then remove the weight. Repeat this process four or five times. The interface between the sensor and the test subject material should be the same during conditioning as during calibration and actual testing.

IMPORTANT! Sensors must be properly conditioned prior to calibration and use.

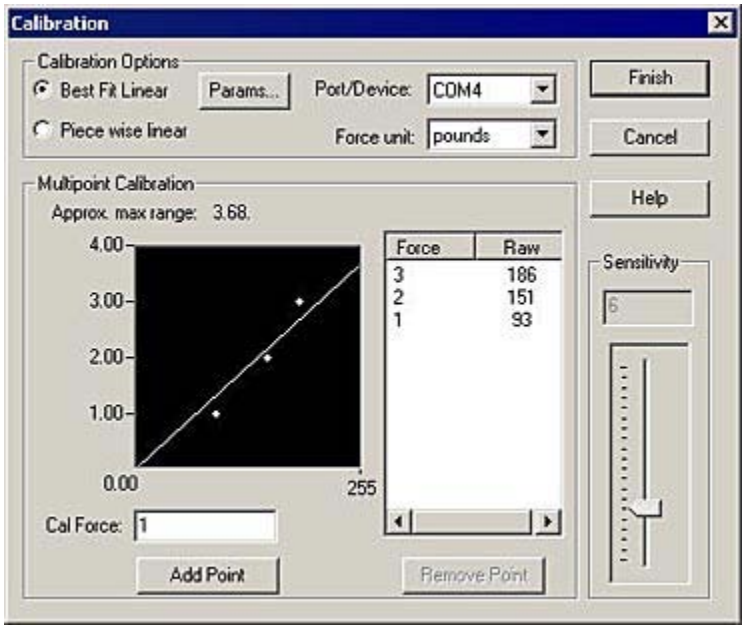
CALIBRATION

The ***ELF*** system sensor acts as a variable resistor in a circuit. This circuit produces a digital output value (between 0-255 Raw) based on the sensor resistance and the system handle's adjustable gain (sensitivity). **Calibration** is the method by which this digital output is related to an actual engineering unit, such as pounds or Newtons. If you are using the Multi-Handle ***ELF*** system, all selected COM ports must be calibrated with at least one point before Calibration can be completed.

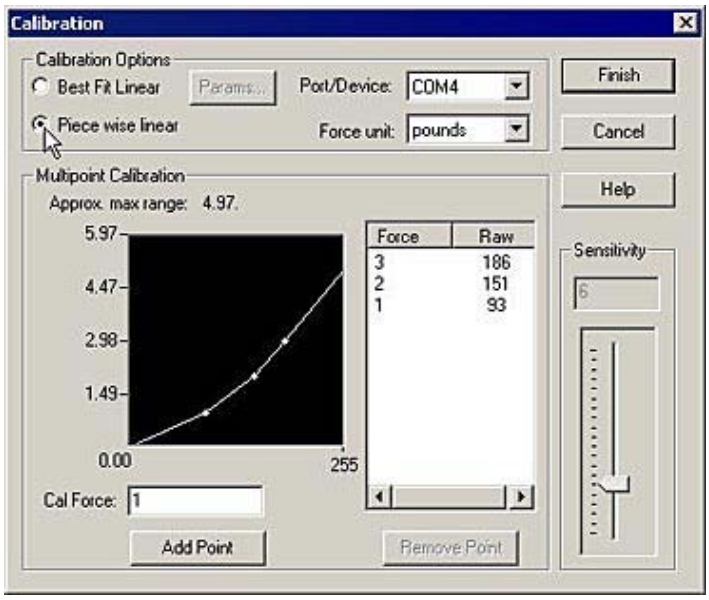
To calibrate, apply a known force to the sensor. The software then equates this applied force to the digital output that it reads, and performs a linear interpolation between zero load and the known calibration load. In this way, the software determines the actual force range that matches the digital output range of 0-255 Raw.

To perform a multi-point calibration, apply at least two known forces to a sensor. The software then equates this applied force to the digital output that it reads, and performs one of two types of interpolation between zero load and the known calibration loads. In this way, the software determines the actual force range that matches the digital output range of 0-255 Raw.

- **Best Fit Linear Calibration:** This calibration creates a best-fit curve through two or more known force values. After a known load is added as a calibration point, select the **Params** button for details about the calibration, including slope, offset and Correlation Coefficient (r2).

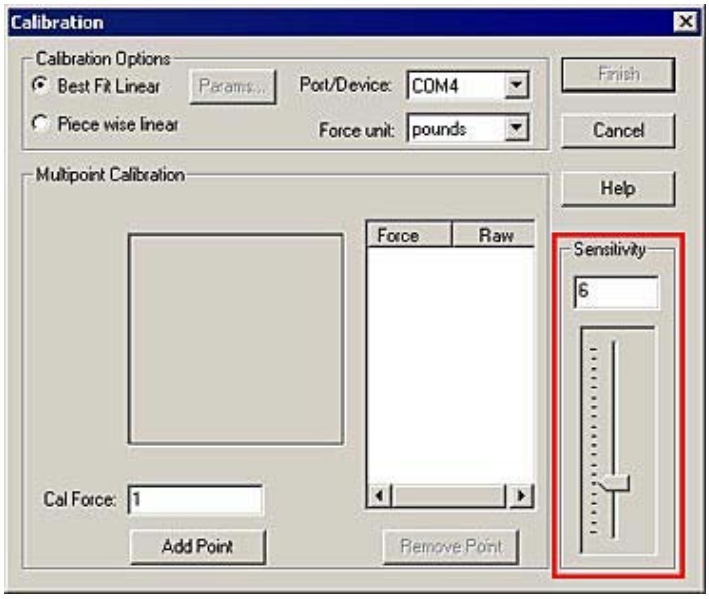


- **Piece Wise Linear Calibration:** This calibration connects each calibration point and interpolates between the values.



NOTE: if you have a Multi-Handle ELF system, all handles must use the same type of calibration. Linear and Best Fit cannot be mixed and matched.

The "Sensitivity" (or "Adjustable Gain") is also adjusted in the *ELF Calibration* dialog box. This adjustment sets the data output range from the computer (0 to 100%) to the actual force range output from the system handle. In this way, the usable force range of the sensor can be adjusted (up to the rated maximum force). "Sensitivity" settings are saved between sessions, and are included with calibration files.



CALIBRATION GUIDELINES

The following guidelines should be considered when calibrating a sensor:

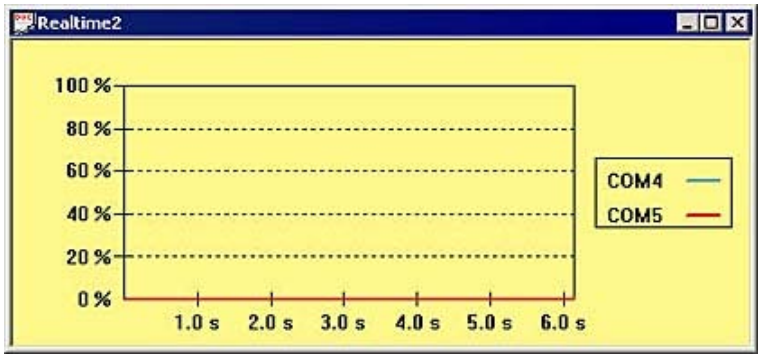
- Apply a calibration load that approximates the load to be applied during system use, using dead weights or a testing device (such as an ***MTS*** or ***Instron***). If you intend to use a "puck" during testing, also use it when calibrating the sensor. See Sensor Loading Considerations for more information on using a puck.
- Avoid loading the sensor to near saturation when calibrating. If the sensor saturates at a lower or higher load than desired, adjust the "Sensitivity".
- Distribute the applied load evenly across the sensing area to ensure accurate force readings. Readings may vary slightly if the load distribution changes over the sensing area.

Note: Read the Sensor Performance Characteristics section before performing a Calibration.

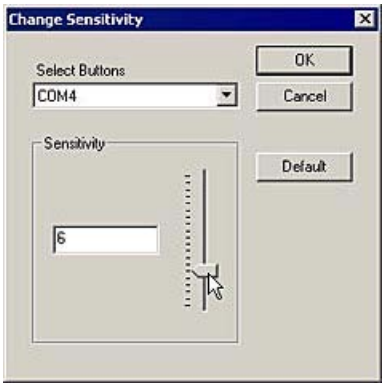
CALIBRATION PROCEDURE

IMPORTANT! Sensors must be properly conditioned prior to calibration and use.

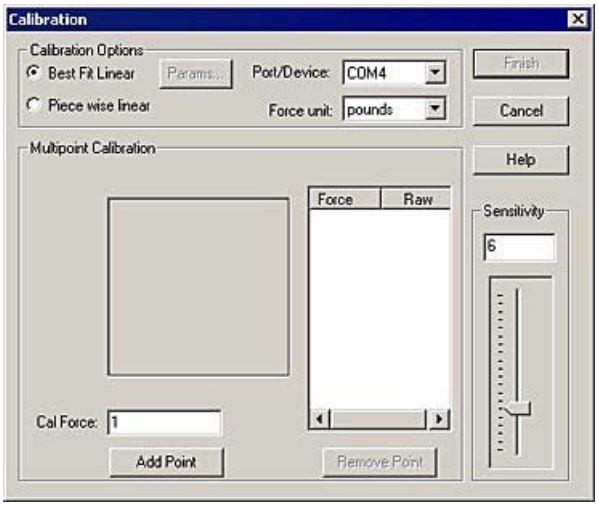
1. Select **File -> New** to open a new Real-time window. If you wish to use a previously saved calibration file, select **Tools -> Load Calibration**, enter the calibration file name and path, and click **OK.**



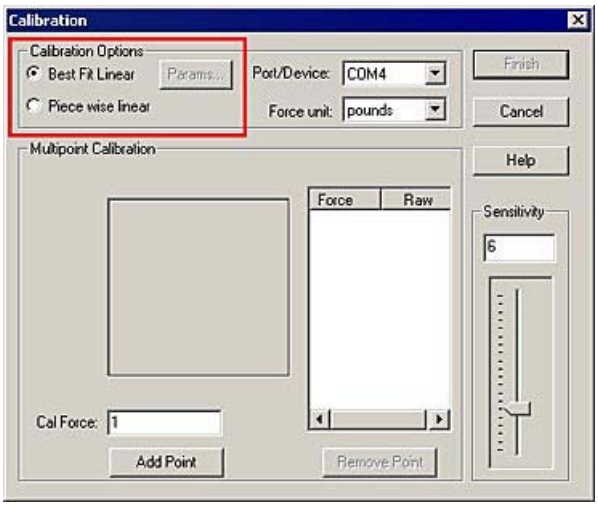
2. Load each sensor with a known force.
3. Click **Tools -> Change Sensitivity**. If you have the Multi-Handle ***ELF*** system, adjust sensitivity for each sensor, if necessary, by either dragging the slider up and down, or entering an integer between 1 and 20 (default is 12). The "Sensitivity" should be adjusted whenever necessary to keep the force display in a usable range.



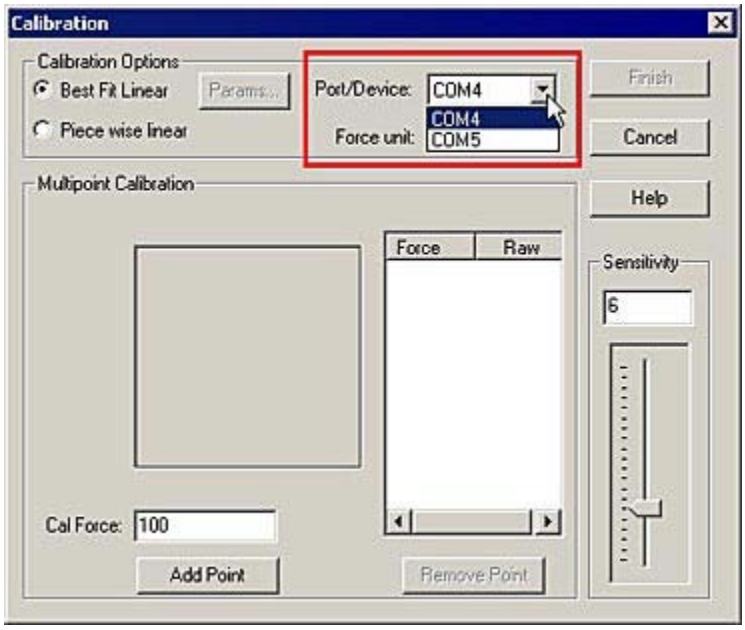
4. Click on Tools -> Calibrate. This brings up the *Calibration* dialog box.



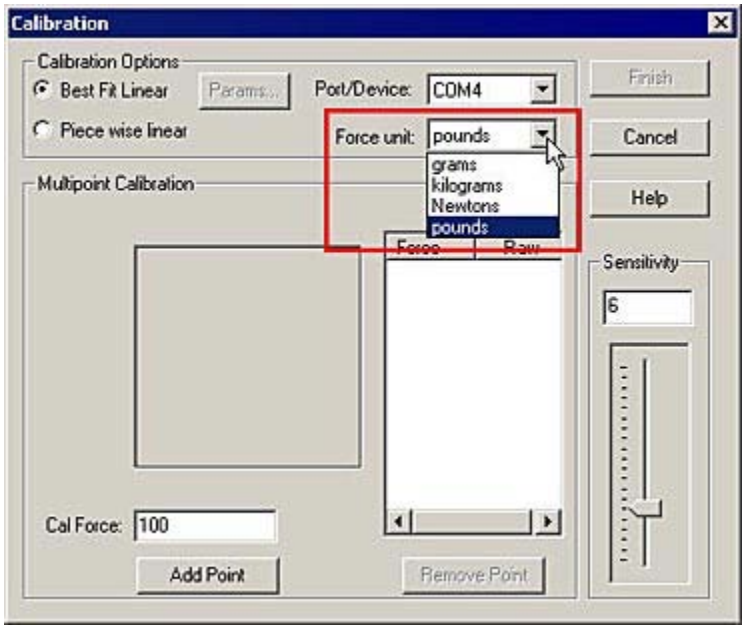
5. Select **Best Fit Linear** calibration or **Piece Wise Linear** calibration.



6. Select the **Port/Device** you wish to calibrate first. If you have the Multi-Handle ***ELF*** system, all Port/Devices must be calibrated before you may select **Finish.**

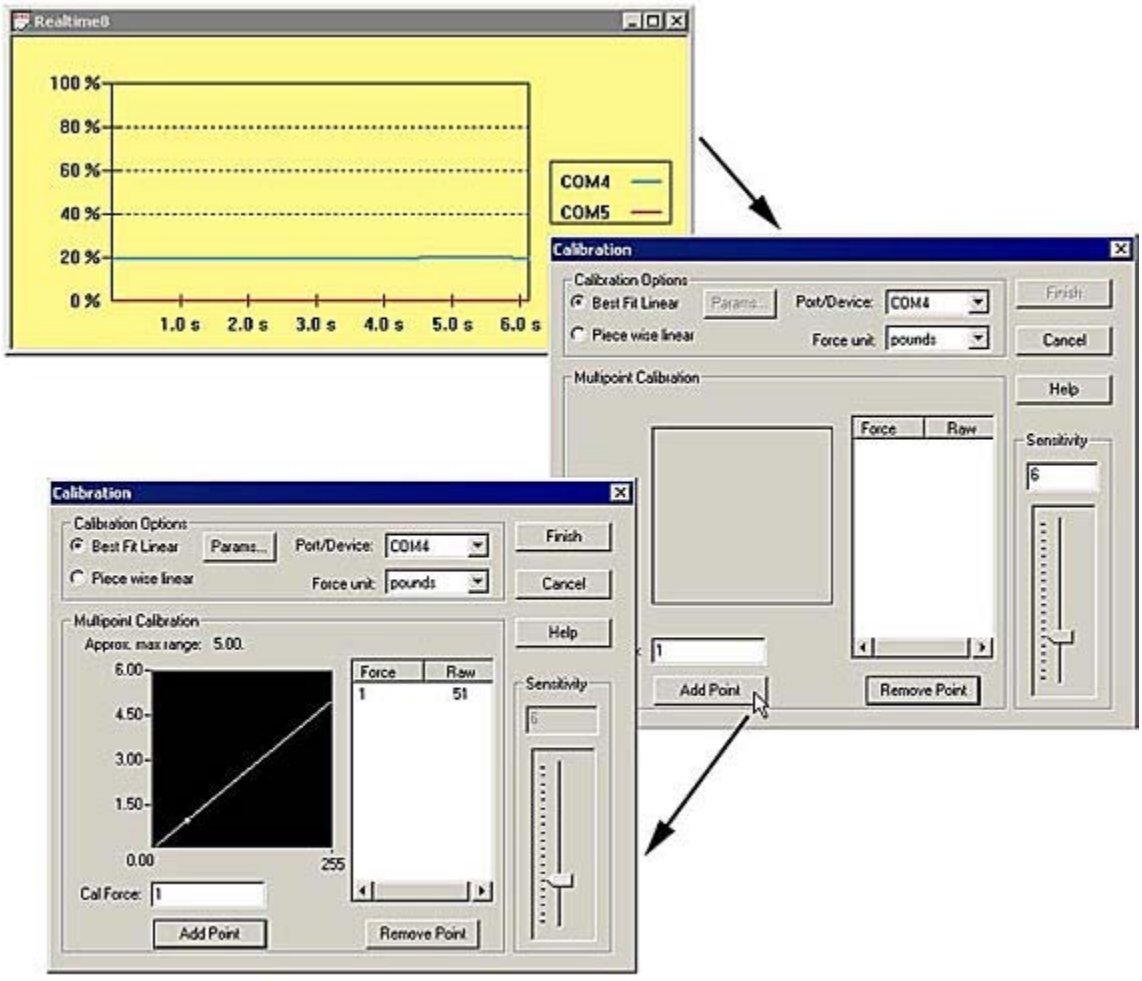


7. Select the appropriate **Force unit** from the drop-down box (grams, kilograms, Newtons, pounds).



8. Load the sensor with a known force. The key to an accurate calibration is applying a stable load. Enter the known load in the **Cal Force** field. If the applied force is not stable, an error message will appear which requires you to either accept or cancel the current calibration.

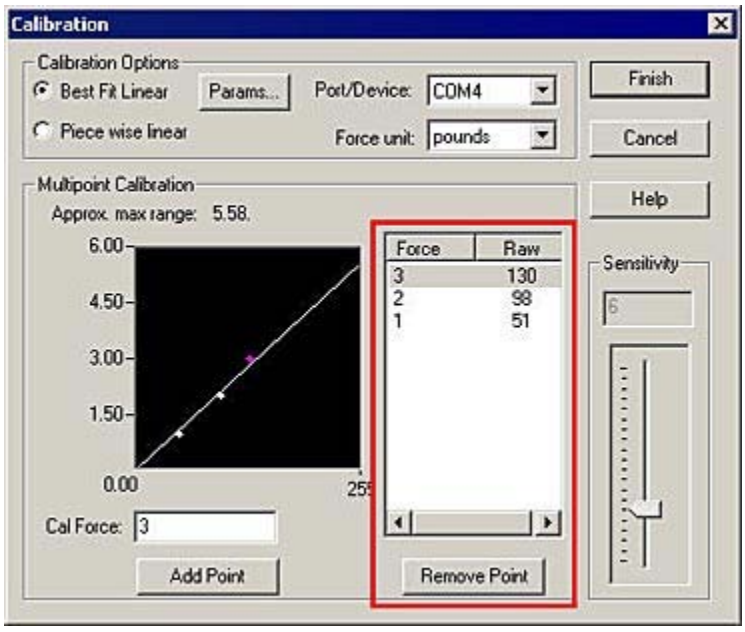
It is recommended that you stabilize the force; otherwise, your calibration may be inaccurate. In the example below, we have loaded the sensor with a 1-pound weight at 20%.



9. Click **Add Point**. A point will appear in the *Multipoint Calibration* box (shown above).

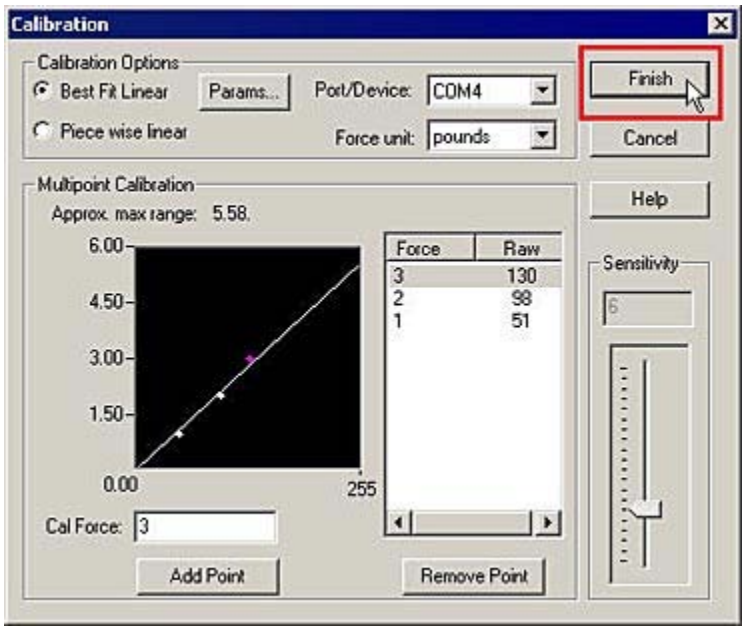
10. Repeat the steps with as many known loads as you wish.

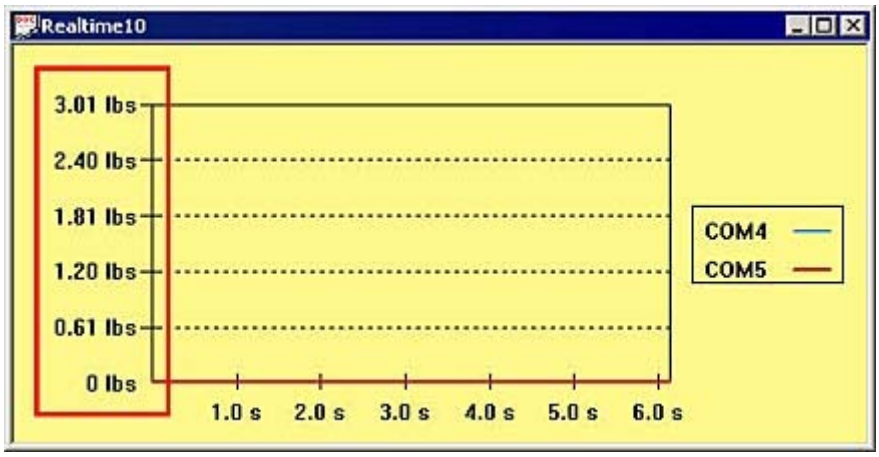
11. If you wish to discard any points, click to highlight them in the **Force/Raw** column. Then select **Remove Point**.



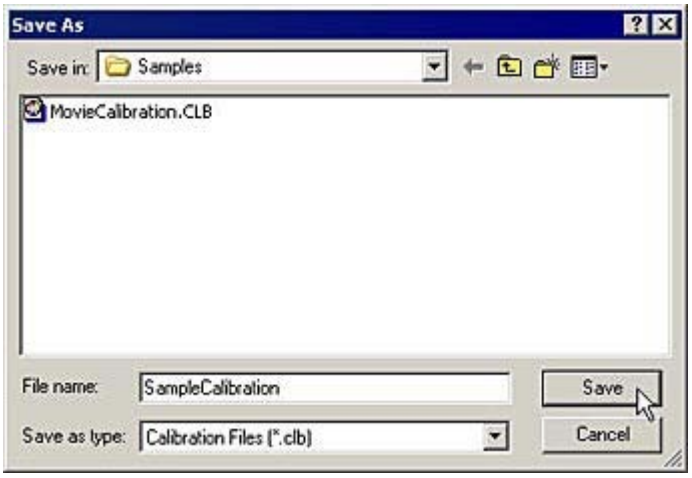
12. If you have the Multi-Handle ***ELF*** system, continue selecting **Port/Devices** and adding as many known loads as you wish, until at least one calibration point has been added for each sensor.

13. Once all Calibration points have been added for all **Ports/Devices**, click **Finish**. The Real-time window will now display force in units of force rather than raw force.





14. If you wish to save the calibration file for future use, select **Tools -> Save Calibration**, and enter the desired destination and file name in the *Save As* dialog box. Calibration files must be saved with the ***.clb** file extension. Sensitivity settings are saved with calibration files.



15. If you wish to recalibrate the sensor during the same testing session, you may either select **File -> New** to get a new Real-time Window, or select **Tools -> Uncalibrate** to reset the calibration of the current window. A calibration will be saved between sessions unless **Uncalibrate** is selected.

SENSOR PERFORMANCE CHARACTERISTICS

There are a number of characteristics of sensors, which can affect your results. This section contains a description of each of these conditions, and recommendations on how to lessen their effects.

REPEATABILITY

Repeatability is the ability of the sensor to respond in the same way to a repeatedly applied force. As with most measurement devices, it is customary to exercise, or "condition" a sensor before calibrating it or using it for measurement. This is done to reduce the amount of change in the sensor response due to repeated loading and unloading. ***FlexiForce*** sensors are generally repeatable within +/- 2.5% once they have been conditioned. A sensor is conditioned by loading it to 110% of the test weight four or five times. Follow the full procedure in the Conditioning Sensors section.

LINEARITY

Linearity refers to the sensor's response (digital output) to the applied load, over the range of the sensor. This response should ideally be linear; and any non-linearity of the sensor is the amount that its output deviates from this line. A calibration is performed to "linearize" this output as much as possible. ***FlexiForce*** sensors are linear within +/- 5%.

HYSTERESIS

Hysteresis is the difference in the sensor output response during incremental step loading and unloading (without going back to zero between measurements), at the same forces. For static forces, and applications in which force is only increased, and not decreased, the effects of hysteresis are minimal. If an application includes load decreases, as well as increases, there may be error introduced by hysteresis that is not accounted for by calibration. For a conditioned sensor, with 50% of the full force range applied, hysteresis is less than 4.5 % of full scale.

DRIFT

Drift is the change in sensor output when a constant force is applied over a period of time. If the sensor is kept under a constant load, the resistance of the sensor will continually decrease, and the output will gradually increase. It is important to take drift into account when calibrating the sensor, so that its effects can be minimized. The simplest way to accomplish this is to perform the sensor calibration in a time frame similar to that which will be used in the application. In ***FlexiForce*** sensors, drift is less than 3% per logarithmic time.

TEMPERATURE SENSITIVITY

The operating range for ***FlexiForce*** sensors is from 15°F (-9°C) to 140°F (60°C). ***FlexiForce*** sensor output may vary up to +/- 0.2% per change in degree F (approx. +/- 0.36% per change in degree Celsius). In general, this effect will be more significant if you combine high loads on the sensor with high temperatures. For loads of less than 10 lbs., the operating temperature can be increased to 165°F (74°C).

To ensure accuracy, calibrate the sensor at the temperature at which it will be used in the application. If the sensor is being used at different temperatures, perform a calibration at each of these temperatures, save the calibration files, then load the appropriate calibration file when using the sensor at that temperature.

FlexiForce sensors should be stored at temperatures in the range of 15°F (-9°C) to 165°F (74°C).

SENSOR LIFE / DURABILITY

Sensor life depends on the application in which it is used. Sensors are reusable, unless used in applications in which they are subjected to severe conditions, such as against sharp edges, or shear forces. ***FlexiForce*** sensors have been successfully tested at over one million load cycles using a 50 lb. force.

Rough handling of a sensor will also shorten its useful life. For example, a sensor that is repeatedly installed in a flanged joint will have a shorter life than a sensor installed in the same joint once and used to monitor loads over a prolonged period. After each installation, visually inspect your sensors for physical damage.

It is also important to keep the sensing area of the sensor clean. Any deposits on this area will create uneven loading, and will cause saturation to occur at lower applied forces.

WIRELESS ELF SYSTEM

The **Wireless ELF System** allows you to transmit force readings from your FlexiForce sensors to your PC without a direct cable connection. The following section explains the setup and operation of this system.

COMPONENT IDENTIFICATION

(1) Hub

(1) Transmitter

(1) USB Cable

(1) AC Adapter (Optional)

Also Included:
(3) FlexiForce WB201 Sensors

TECHNICAL SPECIFICATIONS

Hub: The Hub is powered via the USB port of the PC or Laptop. An ON/OFF switch is provided to control power to the unit. The Hub communicates with the PC or Laptop via the USB port and to the Sensor Modules via an RF link. Network topology: star.

Transmitter: Three AAA Alkaline batteries or an AC Adapter powers the Transmitter. Up to eight Transmitters can communicate with a single Hub via the RF link. Maximum distance without major signal degradation: 200-foot radius.

AC Adapter: The optional AC Adapter can be used if operation of the product is for extended period of time to save on battery life.

Power

Hub: USB powered. USB voltage range is 4.75 V. - 5.25 V. 200 mA max.

Transmitter: Voltage range 4 VDC. min. - 7VDC. max. 180 mA max.

AC Adapter: Input: 100 VAC. – 240 VAC.; 50 Hz. – 60 Hz.; 0.6 A. Output: 5VDC; 2.6 A.

Environmental Conditions

TEMPERATURE: °F (°C)	14 to 131 (-10 to 55) Prolonged use at higher end of temperature range should be avoided
HUMIDITY: %	0 to 90 (non condensing)
PRESSURE: psi (kPa)	1.7 to 14.7 (11.6 to 101.3) (sea level to 50,000 ft)

SETTING UP THE WIRELESS ELF SYSTEM

Software Installation

The ELF and Wireless ELF follow the same software installation procedure. Please refer to the Software Installation section for proper instructions.

Instructions to Connect/Disconnect Power Source

Hub: Turn power switch off and connect/disconnect the USB cable.

Transmitter: Turn power switch off and connect/disconnect the AC adapter. The on/off switch is bypassed if the AC adapter is in place.

Batteries

Use AAA Alkaline batteries such as Energizer #E92 in the Transmitter.

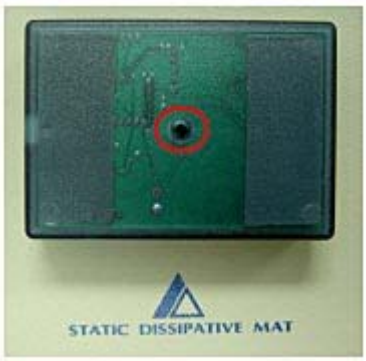
- These batteries are primary cells and are not rechargeable.
- Once the batteries are discharged, replace them with fresh batteries and dispose of the discharged batteries in accordance with applicable laws and methods.
- If the Transmitter is not to be used for an extended period of time, remove batteries from the unit. This avoids damage to the unit if batteries leak.
- Use of other types of batteries may damage unit.
- Use only Tekscan approved AC adapters, cables, and sensors.

Installing the Batteries

To insert the batteries into the Transmitter, follow the procedure below:

Note: To prevent ESD damage to the transmitter, it is recommended that a wrist or shoe grounding strap be worn while handling the bare PCB.

1. With a small Phillips head screwdriver, unscrew the middle screw located on the back of the Transmitter, being careful not to strip the screw when loosening. Remove the screw from the back Transmitter plate (shown at right).



2. Remove the back Transmitter plate to reveal the electronics within (shown at right).

3. Insert three AAA batteries into the exposed battery compartment (shown below).

4. Place the top plate over the electronics. Insert the screw into the back Transmitter plate. Tighten the screw, being careful not to strip the screw.

Troubleshooting

If you are having problems running the Wireless ELF system, try turning off your wireless internet connection. The Wireless ELF system may be experiencing interference with the wireless internet signal. If this does not solve your problem, contact Tekscan Customer Service.

EQUIPMENT MAINTENANCE

- The Hub and Transmitter cannot be autoclaved.
- Do not let any liquid drip onto the electronics inside the Hub and Transmitter. If this occurs, they may stop working and must be allowed to dry for 24 hours. You can use an air syringe, however, to significantly reduce this drying time. Do not attempt to dry out the Hub and Transmitter using any other method, or you may destroy the delicate electronics.
- To properly clean the Hub and Transmitter, be sure to wipe them down with a 70% Isopropyl Alcohol solution. To do this, slightly dampen a cloth with the alcohol solution, careful not to soak or saturate the cloth. Then wipe the Hub and Transmitter after each use.

WIRELESS ELF OPERATION

Wireless ELF LED states

Both Wireless ELF Hub and Transmitter have three LEDs : Red, Yellow and Green. These LEDs are used to display the current state of the system.

Wireless ELF Hub LED states

Power Up

- All LEDs blink once during normal power-up.
- All LEDs blink twice if power-up is due to watchdog reset.

Diagnostics

Diagnostic test are being performed to monitor state of the Hub. If diagnostic test fails due to a missing USB communication, the yellow LED turns on and watchdog reset will occur.

Note: If the PC application is not running it is normal behavior for the Hub to be cycling Watchdog reset repetitively.

Initialization State

- The Red LED On means that the hardware is Initializing. The hub requires an operational transmitter in either scan mode or normal operation mode to complete its initialization. Initialization is complete when the Red LED blinks continually.

Normal Operation State

- Green LED On indicates the Hub is receiving messages from USB and passing them to the sensor.
- Green LED Off indicates No messages to receive.
- Yellow LED On indicates the Hub is receiving messages from Sensor and passing those to the USB.
- Yellow LED Off indicates there are No messages to receive.
- Blinking Red LED indicates idle state and ready to process RF and PC messages.
- Steady Red LED indicates a Communication error/collision is detected; either with USB or RF connection.

Wireless ELF Transmitter LED states

Power Up

- All LEDs blink once during normal power-up.
- All LEDs blink twice if power-up is due to watchdog reset.

Diagnostics

- If the sensor does not receive "keep-alive" messages from Hub, the yellow LED turns on and watchdog reset occurs.

Note: If the sensor is not in range of any Hubs, it is normal behavior for the Sensor to cycle through Watchdog reset repetitively.

Channel scanning state

- Red LED On means Channel Scanning state.
- Green LED On means a "Scan Probe" message is being sent to a channel.
- Green LED Off means that after a "Scan Probe" message is sent to all channels (11-25), the channel is changed or sleeping.

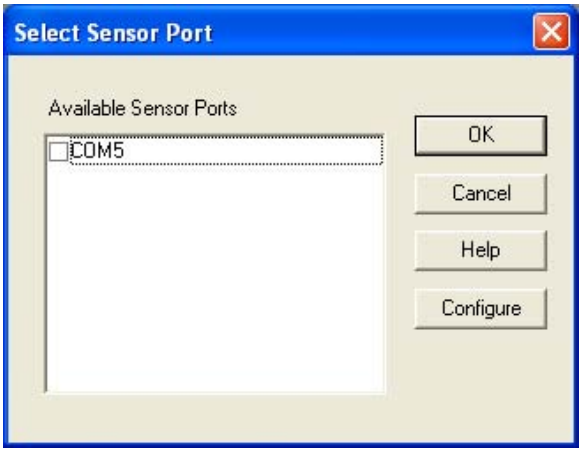
Normal Operation State

- Red LED Off means Normal operation. The Sensor is past "channel scanning" state; initial handshake with Hub has been performed.
- Green LED On means the Sensor is transmitting a message to the Hub.
- Green LED Off means there are No messages to transmit
- Yellow LED On means the Sensor is receiving messages from Hub
- Yellow LED Off means there are No messages to receive

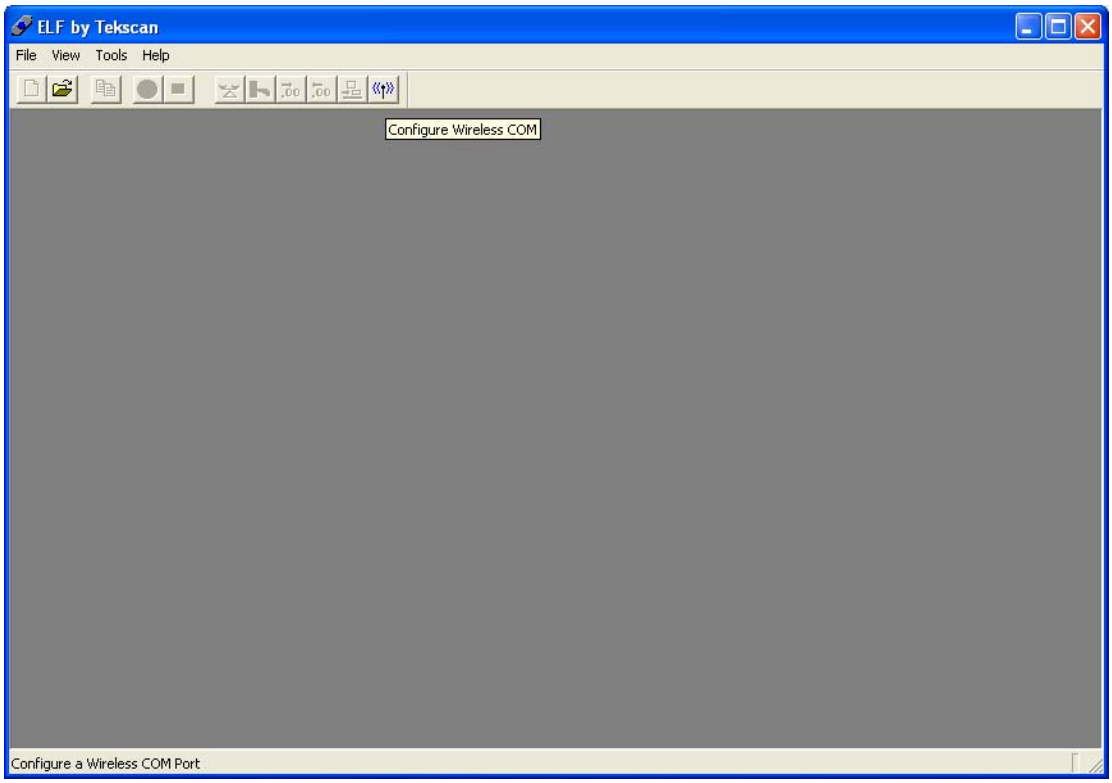
Setting Up Auto-Discovery for the Wireless ELF System

Following is the proper procedure for Auto-discovery:

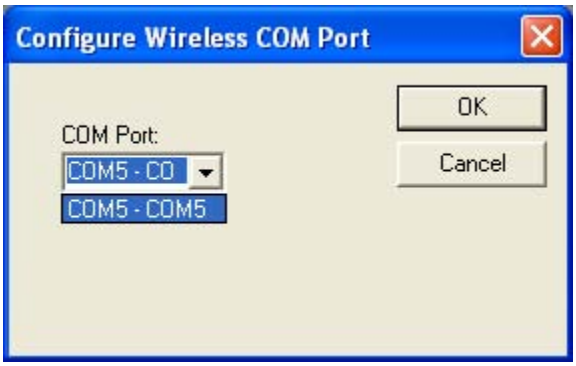
1. Connect the Hub to the computer via the USB/RF cable, and turn it on.
2. Turn on the Transmitter(s) that you want to connect to the Hub
3. Start the **ELF** software. The "Select Sensor Port" window appears. This window shows all available Transmitter(s) and Sensor Ports. In this case, the only port that is found is **COM5**. Press the **OK** button.



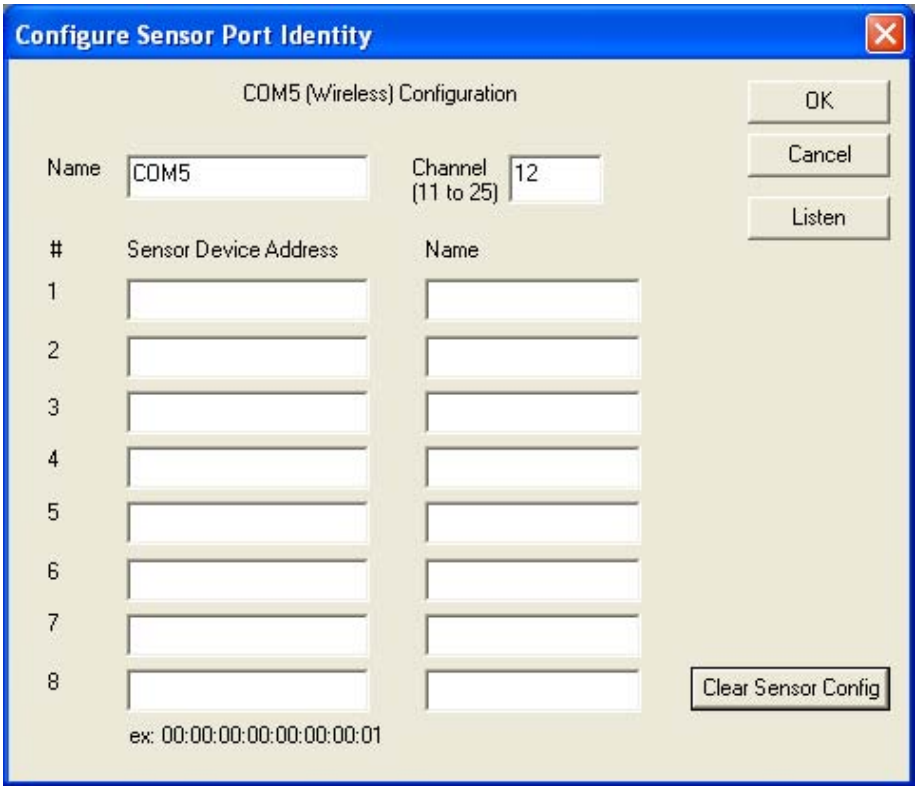
4. From the FlexiForce software main window, press the **Configure Wireless COM** button on the toolbar.



5. The "Configure Wireless COM Port" dialog opens. This is where the Hub Port is selected. The Drop down list shows the currently available COM ports; ports that are communicating with windows applications.



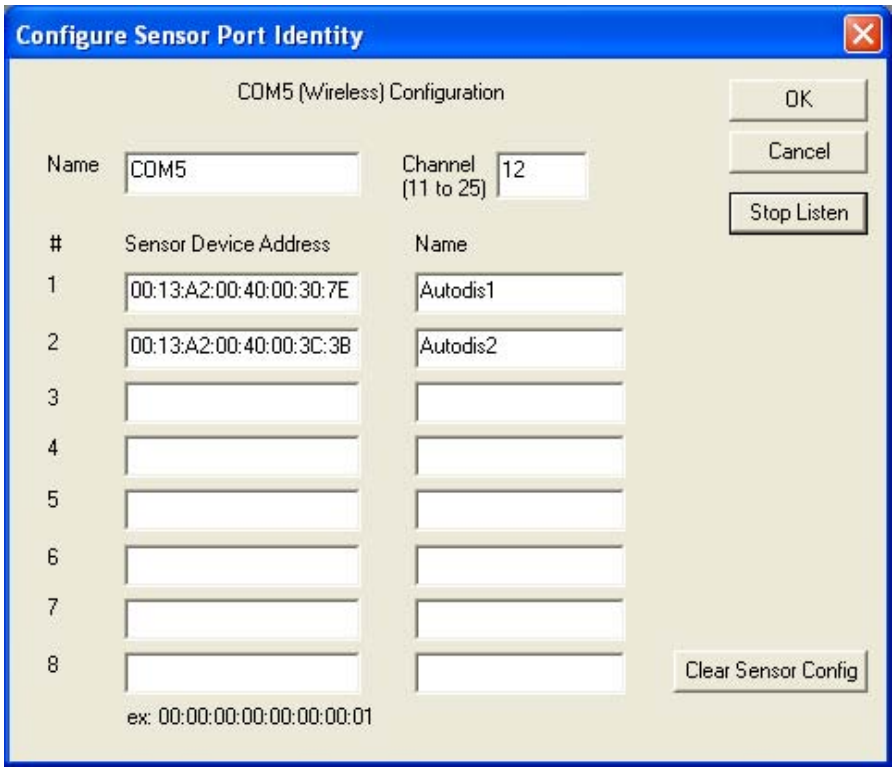
6. After selecting the desired COM port, the "Configure Sensor Port Identity" dialog opens.



7. Press the **Listen** button to start the "Auto-discovery" process. This process will Listen for any wireless Transmitters that are communicating with (connected to) the Hub and automatically populate them into the available slots 1 through 8. The "Sensor Device Address" is input automatically by the detection process.

   By default, the "Auto-discovery" process provides an automatic name for each connected Transmitter in the "Name" field. This name is **Autodis** followed by the number **1-8**. To change this name, overwrite the default name. Providing a unique name for each Transmitter is useful if the user wishes to differentiate between multiple Transmitters within the software.

   Note: The "Auto-discovery" process does not discover devices based on any particular order. For this reason, you may want to label each Transmitter and detect them one at a time. For instance, if you have 2 Transmitters connected, label the Transmitters "1" and "2." Then turn on "Transmitter 1." Press the "Listen" button and when the Transmitter is detected, and the Sensor Device Address is listed in slot 1 in the dialog, provide a useful name for the Transmitter in the "Name" field. Next, turn on "Transmitter 2," and repeat the process. In this way, each Transmitter is detected one at a time and logically Named one at a time.



8. Once each Transmitter is detected, press the **Stop Listen** button.

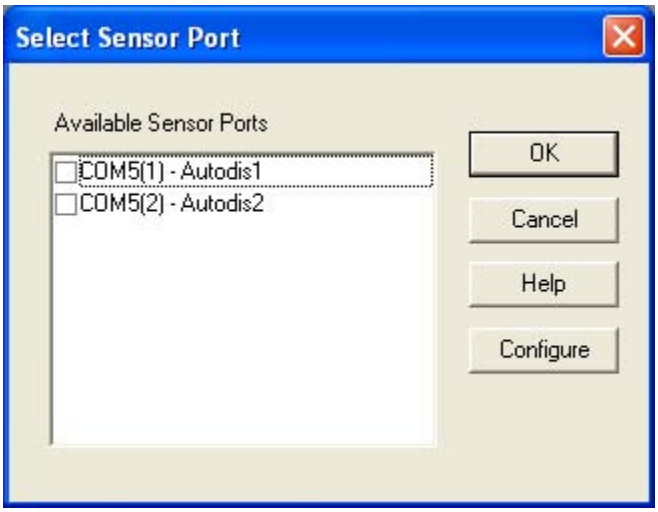
   Note: The Listen/Stop Listen button is a toggle. When Listening for a signal, the text on the button changes to "Stop Listen," and when not actively listening for a signal, the text on the button changes to "Listen."

   If you wish to clear the Transmitters from the Detected list at any point in time, click the **Clear Sensor Config** Button. All connected Transmitters are cleared, and their connection is dropped from the Hub.

   If you have more than one wireless device connected to your computer (for example, if you have 2 Hubs connected, make sure they are assigned different channels in the "Channel" field at the top of the dialog. Available channels are 11-25. Channel **12** is the default Channel, and can be left as is if it is the only wireless device connected to your computer.

9. Click **OK** to close the "Configure Sensor Port Identity" dialog.

10. Press the **New** button on the ELF software Toolbar. The "Select Sensor Port" dialog displays with all available Transmitters. Select the Transmitters to be monitored within the software (see image at right).



11. (Optional) Repeat steps 1-10 for any additional Hubs.

Auto-discovery with Multiple Hubs and PCs

Up to 8 transmitters can be auto-discovered and assigned to a single hub. If additional Transmitters are needed, a maximum of 2 Hubs can be associated with a single PC yielding 16 total Transmitters. The maximum number of Transmitters that can be utilized within a single RF area (200ft radius) is 104 transmitters with 13 Hubs (max 2 per PC). In order to configure this network, the following must be taken into consideration.

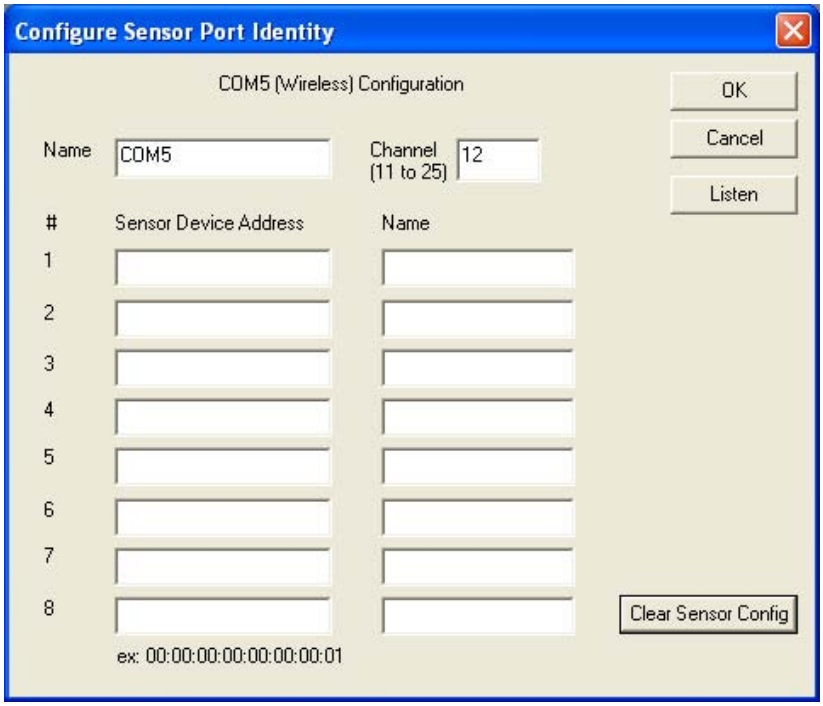
Each Hub needs to be configured to its own channel to prevent channel conflicts. If a channel conflict occurs the following window will be displayed on all PCs where the Hubs are sharing the same channel.

ELF by Tekscan
Channel Conflict on channel 12 detected on Hub at COM7
Please reset your wireless configuration settings and choose a new channel.
OK

Note: The channel warning window will only be displayed once per channel change.

To correct this, perform the following procedure:

1. Repeat steps 4-6 from the previous section: "Setting Up Auto-Discovery for the Wireless ELF System."
2. In the Configure Wireless Devices window, press the **Clear Sensor Config** button to empty the previous Transmitter list.



3. Choose an available channel number, and Press the **OK** button.

4. Repeat steps 4-9 from the previous section: "Setting Up Auto-Discovery for the Wireless ELF System" to auto-discover the available Transmitters in the new channel.

5. Repeat until all operational hubs are allocated to their own channel.

GLOSSARY

A

About Elf (Help Menu): The "About Elf" command displays a dialog window with information about the software version, as well as contact information for Tekscan.

Adjustable Gain: See "Sensitivity".

Arrange Icons (Window Menu): The "Arrange Icons" arranges the icons for minimized windows at the bottom of the main window.

B

Best Fit Linear Calibration: This calibration creates a best-fit curve through two or more known force values. After a known load is added as a calibration point, select the "Params" button from the Calibration dialog for details about the calibration, including slope, offset and Correlation Coefficient (r2).

C

Cal Force: A value that is entered by the user on the Calibration dialog box. This value is the calibration load that is placed on the sensor in order to convert the Digital output into Engineering Units.

Calibrate (Tools Menu): The "Calibrate" command opens the 'ELF Calibration' dialog box, which enables you to calibrate the sensor and adjust the system sensitivity. See "Calibration".

Calibration: Calibration is the method by which this digital output of the sensor is related to an actual engineering unit, such as pounds or Newtons. If you are using the Multi-Handle ELF system, all selected COM ports must be calibrated with at least one point before Calibration can be completed.

Cascade (Window Menu): The "Cascade" command arranges multiple windows in an overlapped fashion.

Change Sensitivity (Tools Menu): The "Change Sensitivity" command opens the Sensitivity Dialog box. You may adjust the sensitivity for each sensor/COM port. Use the drop down Select Buttons field to select the COM port. Then drag the slider up and down until you are satisfied. Adjust as many buttons as you like. When you are satisfied, click OK. To return the system to the original sensitivity settings, click the Default button. See "Sensitivity".

Change Unit (Tools Menu): The "Change Unit" command allows you to quickly change the force units displayed in all windows. To use this feature, however, you must have performed a calibration. Otherwise, all force will be displayed as raw values.

Close (File Menu): The "Close" command causes the currently active Real-time or Movie window to close. If a movie has been recorded, but not saved, the software gives the option of saving the movie file.

Column (View Menu): The "Column" option displays each COM port individually, with force value displayed on the Y-Axis. Each column is color-coded to indicate the individual COM ports. As time elapses, the columns indicate changes in force.

COM Port: The hardware which connects the sensor to your computer. Each sensor is designated a COM Port on your PC. When you open a new Real-Time Window, you must select the Ports that are to be displayed in your Real-Time Window (such as COM 4, COM 5, etc.)

Conditioning: Exercising the sensor prior to Calibration and use. To ensure the most accurate results, it is always recommended to condition the sensor by placing 110% of the test weight on the sensor, allowing it to stabilize, and then removing the weight. This process should then be repeated four or five times. Conditioning your sensors helps lessen the effects of "Drift" and "Hysteresis", and is required for new sensors or sensors that have not been used for a length of time.

Copy (Edit Menu): The "Copy" command saves the current Real-time or Movie frame to the MS Windows clipboard. This data is saved in the clipboard as a graphic (bitmap) image of the current window. Once copied to the clipboard, this data can be pasted into other Windows applications by selecting Edit>>Paste.

D

Drift: Drift is the change in sensor output when a constant force is applied over a period of time. If the sensor is kept under a constant load, the resistance of the sensor will continually decrease, and the output will gradually increase. It is important to take Drift into account when calibrating the sensor, so that its effects can be minimized. The simplest way to accomplish this is to perform the sensor calibration in a time frame similar to that which will be used in the application. In FlexiForce sensors, drift is less than 3%/logarithmic time.

Duration: Refers to a setting within the Recording Parameters dialog box. The Duration is listed below the 'Recording Type'; it will either say 'Until Stop' if Infinite is selected, or the approximate duration (in seconds) the recording will take to complete if Frame Count is specified. See "Recording Parameters".

E

ELF Hardware: The ELF hardware consists of the sensor handle(s), ELF software, and the FlexiForce sensor(s).

ELF Software: The ELF software is an 8-bit application that is compatible with Microsoft (MS) Windows 2000/XP/Vista. The software allows you to view a graphical representation of the force on the sensor in real time, record this information as a 'movie', and review and analyze it later. There are a number of options for displaying the Real-time force data; it can be displayed as a strip chart, column graph, or digital readout. Recorded 'movie' frames can be saved as ASCII (text) files, which can be imported into a spreadsheet program, or opened in a text editor or word processing program. Real-time data or movie frames can also be copied to the Windows clipboard and pasted into other applications as a ".bmp" (bitmap) file.

F

Fast Recording: Refers to one of the Recording Parameter options. When Fast Recording, is selected, the 'Frames to Record' may be entered, and the Recording Frequency (Hz) may be selected to the right. In Fast Recording applications, recordings can be obtained at user-defined frequencies between 10 and 200 Hz (standard system). For the High-Speed ELF system, frequencies as high as 5.7 kHz can be obtained. See "Recording Parameters".

First Frame (Movie Toolbar Playback Controls): Positions the recording at the beginning (First Frame).

Focus: The currently selected Window within your ELF software. Only one window can be selected at a time. A window is selected by clicking on it, and when selected, the title bar will turn blue. When a window is selected in this manner, it is said to have "focus".

Frame Count: Refers to one of the Recording Parameter options. When selected, the number of 'Frames to Record' may be entered at the bottom of the dialog box. The recording will stop when this number of frames has been recorded, regardless of the duration of the movie. See "Recording Parameters".

Frames Displayed: A submenu of the Main Menu. The Frames Displayed Menu provides various display options for the amount of frames shown within the Movie Window (along the X-axis). In addition, you can opt to view the "Entire Movie" within the window's display area.

H

Handle: The handle is a piece of hardware that gathers data from the sensor, processes it, and sends it to your computer through a USB port. See "ELF Hardware" and "COM Port".

Help Topics (Help Menu): The "Help Topics" command opens the help file associated with the Multi-Channel ELF software. About ELF opens the About ELF dialog box, which displays the software and hardware ('device') version numbers for your ELF system, and gives you information on how to contact FlexiForce.

Hi-Speed Recording Parameters: Refers to the options available under the Recording Parameters dialog box. If you have purchased the ELF Hi-Speed system, the software will record at a higher range of speeds, and your Recording Parameters dialog box will look slightly different. Your choices for Recording Type include Infinite, Frame Count, and High Speed. See "Recording Parameters".

Hysteresis: Hysteresis is the difference in the sensor output response during incremental step loading and unloading (without going back to zero between measurements), at the same forces. For static forces, and applications in which force is only increased, and not decreased, the effects of hysteresis are minimal. If an application includes load decreases, as well as increases, there may be error introduced by hysteresis that is not accounted for by calibration. For a conditioned sensor, with 50% of the full force range applied, hysteresis is less than 4.5 % of full scale.

I

Increase / Decrease Decimal: Two icons on the Tool Bar do not have corresponding pull-down menus. They are the Increase Decimal and Decrease Decimal buttons. When sensors have been calibrated, units of force will be shown. Clicking these buttons will either increase or decrease the number of decimal places displayed by the software.

L

Last Frame (Movie Toolbar Playback Controls): Positions the recording at the end of the movie (last frame).

Linearity: Linearity refers to the sensor's response (digital output) to the applied load, over the range of the sensor. This response should ideally be linear; and any non-linearity of the sensor is the amount that its output deviates from this line. A calibration is performed to 'linearize' this output as much as possible. FlexiForce sensors are linear within +/- 5%.

Load Calibration (Tools Menu): The "Load Calibration" command allows you to use the calibration data from a previously-saved file for your current Real-time window. When this item is selected, an 'Open' dialog box appears, and the calibration file can be located and opened. Only ELF calibration files (extension *.clb) can be loaded. The Sensitivity setting that was saved with the calibration file will also be loaded.

M

Main Menu: The Main Menu contains important commands you use to perform functions within the software. Some menu commands can be found directly in the toolbar, however, not all commands found under the menu are located on the toolbar. the Main Menu changes, depending where your focus lies. The reason for this difference is because there are some commands that can only be accessed from a Movie Window, and others from a Real-Time Window. For example, if you have two windows open, one a Real-Time Window, and the other a Movie Window, the Main Menu will contain a different set of submenus and commands.

Main Window: When you initiate the ELF software program, the Main Window is displayed on your computer screen. The Main Window consists of the Menu Bar, Tool Bar, and Main Status Bar, and may contain one or more Real-time or Movie Windows. The window that is selected is considered the active window or the window that has focus. See "Focus". Only one window can be active at one time, and the title bars of the other windows will be grayed out.

Menu Bar: The Menu Bar provides drop-down menus (submenus) used to control the ELF software program. It is located at the top of the Main Window.

Minimum Requirements: The minimum hardware requirements that your computer must meet in order to run the ELF software and operate the hardware successfully. The minimum requirements are: Pentium 300 MHz with 64 MB RAM and 5 MB of Hard Drive Space. In addition, a CD Drive, One USB port per ELF handle, and Windows Operating System (one of the following: 2000/XP/Vista). See "Hardware".

Movie Toolbar (Playback Controls): This bar is located at the top of the Movie Window, and consists of the movie playback icons and the Save As icon. See "Playback Controls".

Movie Window: The Movie Window displays a previously recorded movie. It consists of the display area, scroll bar, the "Movie Toolbar (with playback controls) and the "Movie Window Status Bar".

Multi-Point Calibration: Multi-Point Calibration is a method in which at least two known forces are applied to the sensor and then calculated to convert Digital Output into Engineering Units. See "Calibration".

N

New (File Menu): The "New" command opens a new Real-time window, in addition to any other Real-time or Movie windows that are currently open. The new Real-time window becomes the active window when it is opened. If more than one Real-time window is open, the force data will be displayed in all windows, in unison. If the sensor has already been calibrated, this calibration will also apply to the new Real-time window.

Next Frame (Movie Toolbar Playback Controls): Plays the recording forward one frame each time it is clicked.

Number (View Menu): The "Number" option displays each COM port as numerical values. Each numerical value is color coded to indicate the individual COM ports. As time elapses, the numbers change to indicate changes in force.

O

Open (File Menu): The "Open" command displays the Open dialog box, which allows you to open previously recorded movie files. Only ELF movie files, with the *.flf file extension, can be opened.

P

Piece Wise Linear Calibration: This calibration connects each calibration point and interpolates between the values.

Play Backward (Movie Toolbar Playback Controls): Plays the recording in reverse.

Play Forward (Movie Toolbar Playback Controls): Plays the recording forward.

Playback Controls: The Playback controls are used for movie playback functions. The following functions are available: "First Frame", "Play Backward", "Previous Frame", "Stop", "Next Frame", "Play Forward", and "Last Frame". See "Movie Toolbar (Playback Controls)".

Port: See "COM Port".

Previous Frame (Movie Toolbar Playback Controls): Plays the recording in reverse one frame each time it is clicked.

Properties (View Menu): The "Properties" command opens the Properties dialog box, which allows you to change how the data is displayed on the screen. Any changes made to the Properties will only affect the currently active Real-time or Movie window. The Properties dialog box will also appear whenever you click the right mouse button over a Real-Time or Movie Window. You can select a display option ("Strip Chart", "Column" or "Number"), and also change the "Scale Max", "Scale Min", and "Units".

R

Real-Time Window: A Real-time Window displays the load applied to the sensor as it is happening (in Real-time). The Properties of this display can be changed in the File pull-down menu, or by clicking the right mouse button.

Recording Parameters: The recording parameters act as settings for your Movie. Before you record a movie, you should access the Recording Parameters dialog box by going into Record -> Settings. Within this dialog box you can select what type of recording you are going to create. Things that can be selected are the amount of frames, speed of recording, any triggering options that need to occur before the recording starts, which sensor will trigger the recording, and the type of units (Pounds, Newtons, Kilograms, etc.).

Repeatability: Repeatability is the ability of the sensor to respond in the same way to a repeatedly applied force. As with most measurement devices, it is customary to exercise, or 'condition' a sensor before calibrating it or using it for measurement. This is done to reduce the amount of change in the sensor response due to repeated loading and unloading. FlexiForce sensors are generally repeatable within 2.5% once they have been conditioned. A sensor is conditioned by loading it to 110% of the test weight four or five times.

S

Saturation: The saturation force is the point at which the device output no longer varies with applied force. The saturation force of each sensor is based on the maximum recommended force specified by Tekscan, which is printed on the system packaging or the actual sensor, along with the sensitivity. Sensors are available in three force ranges (Low, Medium, and High), which have specified maximum forces of 25, 150, and 1000 lbf, respectively. The sensor's effective force range (up to the specified maximum) can be altered by adjusting the system sensitivity. Decreasing the sensitivity setting (1 to 20 possible) will increase the force range (displayed as 'Approx Max Range'), and saturation force, of the sensor, and vice versa. It is essential that the sensors do not become saturated during testing. See "Sensitivity" and "Calibration".

Save As (File Menu): The "Save As" command will save the current movie with the specific file name and location of your choice. ELF movie files must have the extension *.flf. This menu item can be used to save a movie file under more than one filename.

Save as ASCII (File Menu): The "Save As ASCII" command saves the current Movie frame as an ASCII file, with the extension *.csv. Since these files are in ASCII (comma separated value) format, they can be imported into a spreadsheet program (e.g. MS Excel), or they can be opened in a text editor or word processing program (e.g. MS Word) in order to review and manipulate the data.

Save Calibration (Tools Menu): The "Save Calibration" command allows you to save your current calibration as a file for future use. When this item is selected, a 'Save As' dialog box appears, and the calibration file can be saved with the specific file name and location of your choice. Calibration files must have the extension *.clb, and can contain up to eight characters. The Sensitivity setting is also saved by the calibration file.

Scroll Bar (Movie Window): The Scroll bar is located directly above the status bar in a Movie Window (at the bottom of the movie window below the force data). It can be used to move to any point (frame) in the movie.

Select Colors (Tools Menu): The "Select Colors" command allows you to customize the background color, as well as the trace color for each ELF device in your View windows. When this item is selected, the 'Select Graph Colors' dialog box appears. By clicking on either Trace Color or Background Color, a Windows color palette becomes available, and you can select one of the standard colors or create your own custom color for each of the COM ports (sensors). The color you choose will be used for all Movie and Real-time windows, and will be set as the default color. To restore the original color, select the Default All Colors button.

Sensing Area: The Sensing area is the silver circle located on the top of the sensor.

Sensitivity: Also referred to as "Adjustable Gain". This adjustment sets the data output range from the computer (0 to 100%) to the actual force range output from the system handle. In this way, the usable force range of the sensor can be adjusted (up to the rated maximum force). Sensitivity settings are saved between sessions, and are included with calibration files. Sensitivity can be accessed directly from the Tools Menu or from within the Calibration dialog box.

Sensor Life / Durability: Sensor life depends on the application in which it is used. Sensors are reusable, unless used in applications in which they are subjected to severe conditions, such as against sharp edges, or shear forces. FlexiForce sensors have been successfully tested at over one million load cycles using a 50 lb. force. Rough handling of a sensor will also shorten its useful life. For example, a sensor that is repeatedly installed in a flanged joint will have a shorter life than a sensor installed in the same joint once and used to monitor loads over a prolonged period. After each installation, visually inspect your sensors for physical damage. It is also important to keep the sensing area of the sensor clean. Any deposits on this area will create uneven loading, and will cause saturation to occur at lower applied forces.

Sensor Temperature Sensitivity: The operating range for FlexiForce sensors is from 15°F (-9°C) to 140°F (60°C). FlexiForce sensor output may vary up to 0.2% per change in degree F (approx. 0.36% per change in degree C). In general, this change will be more significant if you combine high loads on the sensor with high temperatures. For loads of less than 10 lbs., the operating temperature can be increased to 165 °F (74 °C). To ensure accuracy, calibrate the sensor at the temperature at which it will be used in the application. If the sensor is being used at different temperatures, perform a calibration at each of these temperatures, save the calibration files, then load the appropriate calibration file when using the sensor at that temperature. FlexiForce sensors should be stored at temperatures in the range of 15°F (-9°C) to 165°F (74°C).

Sensors: The FlexiForce sensor is an ultra-thin (0.005"), flexible printed circuit. It is 0.55" (14 mm.) wide and 9.0" (229 mm.) in length. Sensors are available in three full-scale force ranges: Low (25 lbf), Medium (150 lbf), and High (1000 lbf). The active sensing area is a 0.375" diameter circle at the end of the sensor. The sensors are constructed of two layers of substrate, such as a polyester film. On each layer, a conductive material (silver) is applied, followed by a layer of pressure-sensitive ink. Adhesive is then used to laminate the two layers of substrate together to form the sensor. The 'active sensing area' is defined by the silver circle on top of the pressure sensitive ink. Silver extends from the sensing area to the connectors at the other end of the sensor, forming the conductive leads. The sensor acts as a variable resistor in an electrical circuit. When the sensor is unloaded, its resistance is very high (greater than 5 Meg-ohm); when a force is applied to the sensor, the resistance decreases. FlexiForce sensors have been successfully tested at over one million load cycles using a 50 lb. force. See also "Sensor Life / Durability".

Settings (Record Menu): Settings: brings up the Recording Parameters dialog box, which allows you to change the current recording parameters. Under 'Recording Type,' there are three possibilities that may be selected. See "Recording Parameters".

Start (Record Menu): The "Start" command is used to make a recording (movie). When Start is selected, the software begins recording a movie of the current Real-time window data using the settings that have been selected (see Settings menu item). When data is being recorded, the Recording In Progress message will appear (shown below), and the Recording On icon (on the Main Tool Bar) will become active (the red circle will become grayed out, and the square "Stop" button -- black color -- will become visible). If 'Triggering' is in effect, and Record is selected, the Waiting for Trigger message will be displayed until the trigger force is reached. Movies created by the ELF system are stored as *.flf files.

Status Bar (Main): The Main Status Bar provides the user with feedback about what is happening inside the ELF software. It will either say 'For Help, Press F1', or will give a description of whichever Toolbar icon is under the cursor. The Main Status Bar is located at the bottom of the Main Window.

Status Bar (Movie Window): The Movie Window Status Bar is located at the bottom of the Movie Window, and displays the Frame count (the current frame number vs. the total number in the movie).

Status Bar (View Menu): The "Status Bar" option is used to display or hide the Movie and Main Status Bars. These status bars can be toggled by clicking this menu item on and off. If a Real-time window is active, this menu item affects the Main Status Bar. If a Movie window is active, this menu item affects the Movie Status Bar.

Stop (Movie Toolbar Playback Controls): Stops playback.

Stop (Record Menu): The "Stop" command will cause the software to stop recording the active Real-time window, even if the correct number of movie frames (as selected in Settings) have not yet been recorded.

Strip Chart (View Menu): The "Strip Chart" option is the default display mode, where force value is displayed on the Y-Axis and elapsed time is displayed on the X-Axis.

T

Temperature Sensitivity: See "Sensor Temperature Sensitivity".

Threshold: Refers to a value within the Recording Parameters that is set by the user. The Threshold may be set for each individual COM port, so that each sensor has a different Threshold. This may be used in combination with the Trigger Force value to begin recording when force is exerted on a specific sensor. See "Recording Parameters".

Tile (Window Menu): The "Tile" command arranges multiple windows in an overlapped fashion, either vertically or horizontally.

Toolbar: The Toolbar provides some of the same options as the Menu Bar, but with icons replacing drop-down menus. It is located directly below the Menu Bar, at the top of the Main Window. Note that not all items in the Menu Bar have a corresponding icon on the Tool Bar.

Toolbar (View Menu): The "Tool Bar" option is used to display or hide the Movie and Main Tool Bars. These tool bars can be toggled by clicking this menu item on and off. If a Real-time window is active, this menu item affects the Main Tool Bar. If a Movie window is active, this menu item affects the Movie Tool Bar.

Trigger Force: See "Triggering".

Triggering: Refers to the Recording Parameters dialog box. This dialog box allows you to 'trigger' the start of a recording based on a force value. If you enter a value in the 'Trigger Force' field, and select the appropriate measurement units, recording will not begin until that force is exerted on the sensor. Enter a zero in this field to disable 'triggering'. Only one Trigger Force value may be entered, and will apply to all sensors being used for testing. See "Recording Parameters".

U

Uncalibrate (Tools Menu): The "Uncalibrate" command removes the sensor's calibration data. When this item is selected, a dialog box will appear, giving the option of canceling the Uncalibrate operation. Uncalibrate does not affect the Sensitivity setting. See "Sensitivity".

Z

Zeroing Preload (Tools Menu): The "Zeroing Preload" command modifies the calibrated data to correct for residual pressure (referred to as the 'Offset Load') on the sensor at zero load. This operation is useful if the sensor is under some load for the entire duration of the recording, or if the sensor must be secured in place by hardware which would cause load to be detected by the sensor. The raw data is not affected by the Zeroing Preload function, but an extra calculation is performed when converting the raw data to calibrated data. If the sensel is reading raw pressure, it is set at zero raw before the calibration scale factor is applied. Zeroing Preload is recommended only for single point calibration and may increase error when using a multi-point calibration.